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Environmental Science & Engineering is a bi-monthly business publication of Environmental Science & Engineering Publications Inc. An all Canadian publication, ES&E provides authoritative editorial coverage of Canada's municipal and industrial environmental control systems and drinking water treatment and distribution.

Readers include consulting engineers, industrial plant managers and engineers, key municipal, provincial and federal environmental officials, water and wastewater plant operators and contractors.

Information contained in ES&E has been compiled from sources believed to be correct. ES&E cannot be responsible for the accuracy of articles or other editorial matter. Articles in this magazine are intended to provide information rather than give legal or other professional advice.

Canadian Publications Mail Sales
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Registration No. 7750

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Tel: (905)727-4666
Website: www.esemag.com

A Supporting Publication of



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June/July 2020 • Vol. 33 No. 3 • ISSN-0835-605X



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2020 – The year the earth stood still

The *Day the Earth Stood Still* is a classic 1951 film about a humanoid alien visitor named Klaatu that comes to Earth, accompanied by a powerful eight-foot tall robot, to deliver an important message that will affect the entire human race. To demonstrate his race's technical superiority and to get the attention of world leaders, Klaatu neutralizes all electricity everywhere on the planet for 30 minutes, except for such essential services as hospitals and airplanes in flight. Basically, bringing the world to a standstill.

How ironic is it that some 70 years later, an invisible invader would in real life bring society to a virtual standstill globally, and seemingly will continue to do so for at least a year? COVID-19 has spread globally, despite the 100 plus years of technical and medical advances we have made since the Spanish Flu pandemic of 1918, which infected some 500 million people worldwide and killed an estimated 20 to 50 million.

While the immediate health concerns of COVID-19 are of course priority, the effects of this “standstill” situation are far reaching. For the first time in their histories, water and wastewater associations had to cancel their annual conferences and tradeshows. Virtual events are being promoted out of necessity and, while they can no doubt help in the transfer of knowledge, I truly believe they cannot replace the intrinsic value of in-person networking and face-to-face conversations.

Since 1992, ES&E has organized CANECT, which has grown to be the largest environmental due diligence event of its kind in Canada. In mid-March, we had to announce the postponement of CANECT 2020 until October 20 – 22. At this time, we are still hopeful it will proceed as a live event, with strict social distancing and sanitization protocols in place. But, we shall see.

Annually, ES&E exhibits at AWWA's ACE and WEFTEC. Being the largest water and wastewater events in North America, they give an insight into the importance of these sectors, and offer a rare chance to see full-scale equipment. With attendees from around the globe, they allow international knowledge transfer and, to some extent, cultural exchange. Certainly, I will miss attending these events this year.

In May, I concluded my term as president of the Ontario Pollution Control Equipment Association, my third since first being elected to the board in 1990. Founded in 1970,

OPCEA has always held an annual general meeting, which until recently was an afternoon/evening event, featuring guest speakers, a networking reception and dinner. This year, however, we had to hold a virtual AGM. Yes, members who joined in got an update on OPCEA, but I for one missed seeing old business friends, and the chance to meet those just starting out in the field.

Equipment manufacturers and distributors are also having to adjust to this situation. In addition to not being able to educate industry professionals at tradeshows, they are not able to send sales staff out to meet with clients and prospects. As water and wastewater projects often take years to design and complete and involve multiple stakeholders, I have been told many times that establishing personal relationships early on is vital.

Many have come to realize that it is more important than ever to keep up marketing plans, including traditional print media, webinars, etc., and I would like to thank our advertisers and authors for continuing to have faith in ES&E Magazine and our ability to connect them with the water, wastewater and environmental protection sectors. Thank you to our readers as well, for continuing to turn to us for news and information.

This year will continue to be challenging for us all. But, seeing that we are all involved in the essential areas of water, wastewater, industry and environmental protection, I believe we are better off than a lot of other sectors. ■



Steve Davey is the editor and publisher of ES&E Magazine. Please email any comments you may have to steve@esemag.com.

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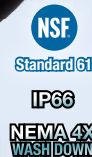
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WHAT ROLE CAN INFRASTRUCTURE PLAY IN THE GLOBAL ECONOMIC RECOVERY?

By **Michael S. Burke**

As the coronavirus outbreak deepens and inflicts a tragic toll, economies around the world are being flattened with unprecedented force and speed. Governments are advancing emergency aid and stimulus packages to respond to the immediate health crisis and prevent economies from stuttering to a halt.

The global community has been badly shaken, but already there is a determination to emerge from this stronger, to rethink how we do things and reboot. For the infrastructure industry that means asking how can we make populations more resilient to global shocks ahead? Can we approach what we design and build better?

Of course, the scale of what's required is immense. The U.S. government has responded with a \$2.2 trillion package, the largest federal relief effort in that country's history. Underscoring the magnitude of the challenge, a further stimulus package, possibly even larger, is already in the works, including major infrastructure investment plans.

In Asia, where the outbreak began, record stimulus packages have been announced in Japan, Singapore and South Korea, while Australia's efforts to date amount to one tenth of its economy. China has signalled a bigger stimulus could be on the way.

Meanwhile, European Union leaders are working on a collective response. Italy, France and Germany have laid out their own relief efforts, ranging from €25 billion to €50 billion, and Spain is planning the biggest financial mobilization in its democratic history. The U.K. has already promised to pump more into its economy than during the decades-old financial crisis.

Despite these best efforts, financial markets remain skittish and fearful of how much this will cost. It is impossible to predict the full economic impact of the coronavirus because we still don't know how long we will have to fight it, and how much of resources the effort will consume. The International Monetary Fund expects the GDP growth for 2020 to be negative, with "a recession at

least as bad as during the global financial crisis or worse."

It is likely that additional stimulus packages will be required, beyond those already announced. Underneath the headline figures will come important choices about how to spend that money. Those decisions will impact the speed and depth of recovery, influence the longer-term health of our economies, and begin to define what our new normal is likely to be once the coronavirus is abated – hopefully for good.

A time-honoured way of providing an immediate lift to economies is to fund infrastructure. The injection of income leads to more spending, which creates more income and so on – the so-called "multiplier" effect. A study for Business Roundtable, an association of chief executive officers of America's leading companies, found modernizing highways, bridges, airports and waterways will produce big returns.

Every dollar invested in infrastructure returns roughly \$3.70 in additional economic growth over 20 years, the



modelling study by University of Maryland showed. That's nearly a 4:1 ratio of return on investment. During a recession, infrastructure investment is often deficit financed, meaning it can have an even greater effect.

At the same time, spending on infrastructure boosts economic prospects in the medium and long term through much-needed improvements to facilities and connectivity. On average, \$100 billion of infrastructure investment adds one million jobs. More if the projects are transport-related because of the knock-on effects of a more efficient economy.

To avoid delays in awarding construction projects, agencies should start preparing now. Much of the planning work, from accelerating permitting to tender documentation, can be done virtually. Administrations should begin fast track planning and environmental approvals now and engage the industry to help clients prepare projects for procurement.

Projects can be delivered faster thanks to design-build, which allows projects to start sooner, and digital delivery, which improves efficiency. These methods should be embraced, as should the encouragement of unsolicited proposals and the engagement of the private sector in financing of projects.

When stimulus funding becomes available, it will be most impactful if a comprehensive infrastructure stimulus program can help guide priorities. We need

Spending on infrastructure boosts economic prospects in the medium and long term through much-needed improvements to facilities and connectivity.

a program that channels the same ingenuity driving today's healthcare response into new thinking to address disrepair and build infrastructure for the future.

While immediate payouts are needed to keep households and businesses afloat, infrastructure spending provides one of the greatest returns on investments in the longer term. Incorporating a full asset life cycle approach that balances shovel ready projects with more strategic priorities, we can help make our urban centres more resilient to global shocks such as climate change and urbanization.

With the right choices we can create a more sustainable future for a global population that has been burdened by weeks of keeping physically distant, to help us come together to rise above this tragic period.

After the devastation of World War II, the world enjoyed an economic boom, financed in part by the massive need to rebuild large swathes of Europe and to

support suffering economies. Despite unprecedented hardships, some of the greatest public works projects in history began in this period – from the U.K.'s New Towns program, that saw the construction of over 20 entirely new settlements, to President Eisenhower's new Interstate Highway System.

The legacy of such projects should serve as an inspiration to today's policy makers of what they can achieve. ■

Michael S. Burke is chairman and CEO of AECOM. For more information, visit www.aecom.com

Editors Note: The Canadian government has also provided hundreds of billions of dollars in personal and corporate aid and has committed to helping municipalities manage their fiscal shortfalls as a result of COVID-19.



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UNLOCKING DATA FROM WATER, WASTEWATER AND STORMWATER SYSTEMS

By **Tim Finegan**

Technological advances have created an explosion of data in all aspects of our lives and water is no exception. Governments and utilities are in various stages of maturity in collecting and analyzing water data from a variety of applications.

Using data from hydrological systems, organizations can properly account for and appropriately allocate water resources while minimizing impacts on the environment.

Data collected from reservoir levels, stream-flows, combined sewers, storm sewers, and rainfall allows environmental organizations to take preventative action against flood and contamination dangers.

By bringing together data from all water facilities, lab testing results, and compliance regulations, organizations can ensure safe drinking water for everyone.

Industrial pretreatment compliance can be better managed with the right data analysis and governance in place.

Effectively managing a highly regulated resource such as wastewater requires accurate data, advanced record computation and sophisticated analysis.

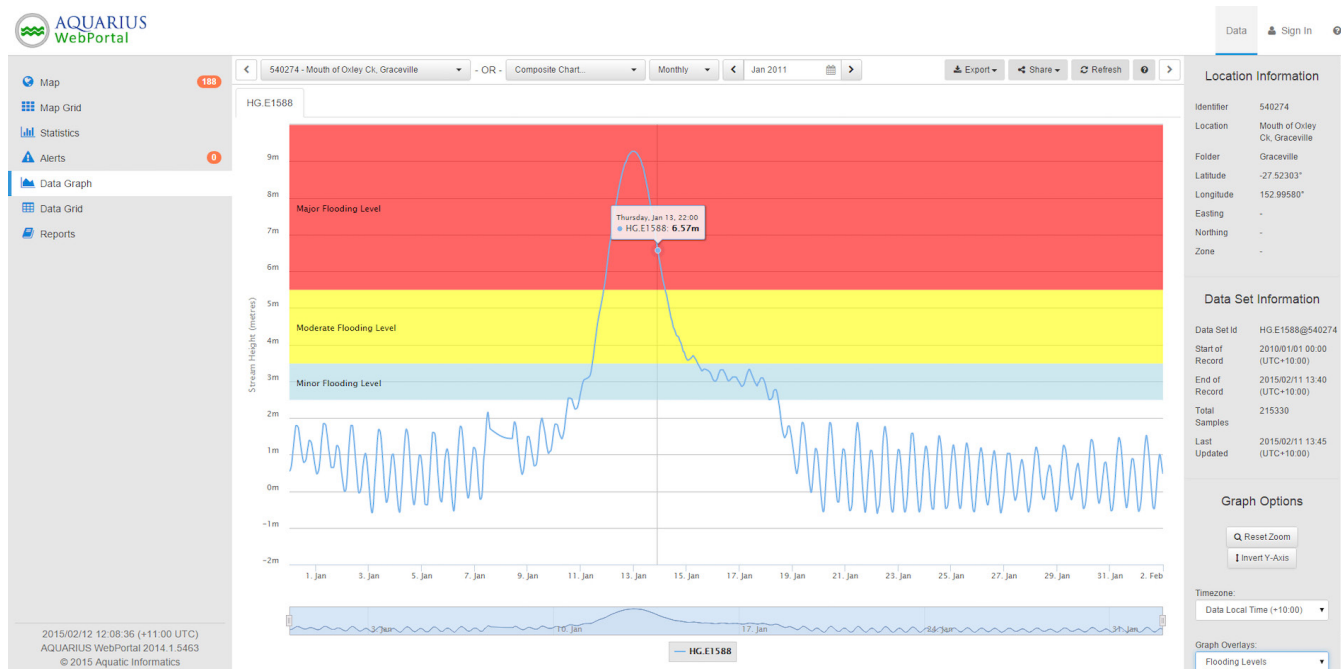
Keeping track of activities and evaluating fats, oils, and grease (FOG) program compliance can provide data to help reduce the risk of blockages and spills, and work with industry to mitigate violations.



WaterTrax responsive KPI dashboards inform field users where to sample and catch data entry errors directly from the mobile web app.

The problem is that much of the data gathered often lives in various silos in, and across, provincial and local government and industry organizations. So, despite the availability of potentially helpful technologies, such as sensors and software tools, water utilities often lack the information they need to better conserve and adequately manage water.

Others may have lots of data, but lack the ability to glean insights from it. Therefore, it's vital that organizations have the



AQUARIUS gives some context to your data. This image shows the water levels at a specific station. The colour bars show flooding levels.

right tools for proper analysis, in order to complete critical tasks such as predicting issues, and prioritizing and repairing aging water infrastructure, such as that which causes non-revenue water losses.

Chris Misson of Aquarius says that “Organizations need to find a way to break down silos, consolidate data, and make sense of that data to achieve better, more sustainable water management.” Water monitoring agencies use analytics software to acquire, process, model and publish water information in real time.

“Usually it’s a crisis that spurs action. The shock of running out of water or having a community’s water contaminated does make governments, industry and the public demand change. However, it’s far less costly to address issues today so that you can plan for tomorrow,” says Misson.

To build a business case for tapping into all streams of water data, organizations need to bring together a cross-functional team with representation from people on the ground, strategic planners and business intelligence.

Start by asking the right questions. Try to solve a small problem and use that as leverage to get more funding to build the people, process, and technology that can help make real strides towards reaching

four water data management milestones:

1. Water data consolidation to break down data silos.
2. Water data analysis to turn raw data into actionable insights.
3. Internal knowledge sharing across organizations, government departments, and international bodies.
4. External knowledge sharing with industry and the public to educate, inform, and encourage respect for one of our most important resources.

By connecting the dots between water data sets, we can proactively predict issues, and ultimately better protect communities and ecosystems.

John Yap of WaterTrax says that “by sharing vital water data with the public, with regulators, and with international bodies, we can raise awareness, better predict events and drive real sustainable change.” WaterTrax is a software program


that helps agencies and utilities monitor and manage their water and wastewater system data to streamline regulatory compliance practices and improve data integrity.

A report by the Canadian Water Network (CWN) highlighted the mounting financial pressures facing Canadian water utilities. “*Balancing the Books: Financial Sustainability for Canadian Water Systems*” acknowledges the widening gap between customer expectations and water system revenue to fully recover costs.

This is not just a Canadian problem, as there are similar scenarios in cities and countries all over the world. Perhaps because water is largely unpriced, global water infrastructure is drastically underfunded. Sharing data about water can change this.

By sharing information with the public about water conservation efforts in their communities, governments can help change attitudes about the value of water. This can open up dialogue about new pricing opportunities for water, sim-

continued overleaf...



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ilar to other government-owned utilities, whereby the resource is based on supply and demand.

Attitudes towards sharing of water data are already changing. NASA shares water data to support water management efforts in the U.S. and internationally. NASA's Gravity Recovery and Climate Experiment (GRACE) satellites measure the environmental and human impacts on water across the planet.

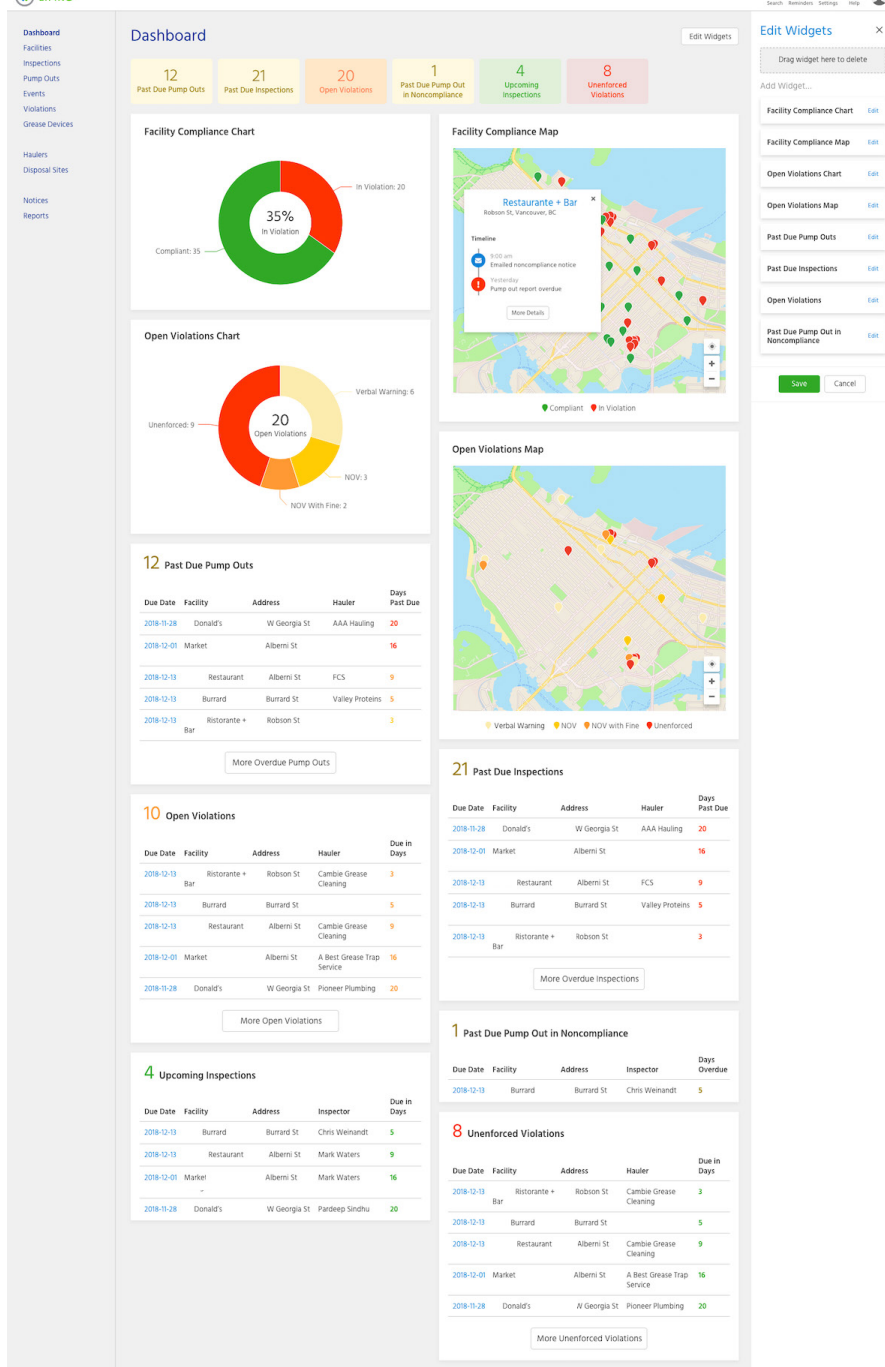
In the U.S., the agency's Western Water Applications Office works with multiple entities to track how drought affects agriculture and water supplies. Globally, agricultural irrigation accounts for 70% of water usage. By contrast, municipal water represents a mere 8% of global use.

Wasteful irrigation systems on farms consume over double the freshwater of any other industry. Inefficient irrigation practices in farming can hurt water in other ways, such as washing pollutants into rivers, streams or other freshwater ecosystems.

Monitoring river and groundwater quality is the first step to identifying contaminants of agricultural run-off. "If this information is available to all stakeholders in a timely fashion, as in near real time, you have true transparency for immediate action," says Misson. "The farmer can fix the irrigation inefficiency and steps can be taken to treat or discard the contaminated water and prevent a health advisory or ecological domino effect."

NASA also works with the U.S. Agency for International Development to provide satellite data, computing tools and training through the SERVIR program. The program is intended to help African partners generate better flood forecasts. GRACE satellites also monitor water and ice inventory in the glacier-covered Himalayas to improve understanding of how the climate is changing snow packs.

Consolidating NASA data with local water data could help move us towards sustainability of water sources worldwide. The data generated from all monitoring activities can allow water resource managers to identify where pollution problems exist, where to focus pollution control activity, and where progress has been made.



The Linko Online Dashboard provides at a glance compliance information that can be configured by end users through the drag and drop widget interface.

Most municipalities are already using some degree of water data management tools to monitor and manage the entire health of the water cycle. Streamlining and unlocking that data within organizations and across community lines and around the world, is proving to be beneficial and achievable with cloud-based solutions. Friendly user interfaces are

also improving public access to that data and providing sustainable communications to all stakeholders. ■

Tim Finegan is with Aquatic Informatics. Email: info@aquaticinformatics.com, or visit www.aquaticinformatics.com

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NEW WATER TANKS HELP SAINT JOHN DELIVER ABUNDANT AND CLEAN WATER

By **Jessica Gregory**

Residents on the east side of Saint John, New Brunswick, were all too familiar with boil water orders. For decades, the city drew water from Latimer Lake and chlorinated and pumped it directly to the distribution system. This meant that even the smallest issue with the chlorination process would necessitate the issuance of a boil order. Events as simple as “bad weather” could stir up sediment in Lake Latimer and cause significant problems.

“Flow was everything because we didn’t have water in reserve,” says Dean Price, project manager for the City of Saint John. “When your only source becomes contaminated, you have no other option but to warn people, and they become the last line of defence, which isn’t an ideal situation.”

In 2013, the City of Saint John Common Council launched the “Saint John Safe Clean Drinking Water Project”, the largest municipal infrastructure project in New Brunswick. The project was jointly funded by the Province of New Brunswick, Infrastructure Canada, and a group of private equity partners, including Acciona, Brookfield, and North America Construction.

Engineering firm CBCL was retained to develop the scope of work and conceptual design, and produce preliminary design drawings for the request for proposal. After a full review of the project, Port City Water Partners was awarded the contract for the design, build, and finance. They will operate and maintain the new facility for the next 30 years. This type of agreement, called “Design-Build-Finance-Operate-Maintain” or DBFOM, is an increasingly popular method of building water and energy infrastructure, as it transfers most of the risk to the private sector.

Part of this project included building the Loch Lomond Drinking Water Treatment Facility to service Saint John residents. Water quality from the facility is



Overview of the Loch Lomond Drinking Water Treatment Facility. North America Construction (1993) Ltd.

significantly improved compared to the water quality from the former Latimer Lake Chlorination Facility. The new facility added several additional filtration steps to deliver drinking water that exceeds provincial and national standards. These include a dissolved air flotation process, advanced filtration, chlorination, disinfection and pH correction.

Considering the scope of the project, staying on budget and completing it on time were two critical components in its success. With system upgrades, including improvements to the surrounding watershed, water storage, pumping stations and transmission system, and the replacement and rehabilitation of water pipes, the project cost topped out around \$228 million.

There have been 26 km of transmission system infrastructure improvements, including upgraded distribution mains. Planning began back in 2013, but actual construction of the new facility started in 2016 and reached substantial comple-

tion in June 2019. At this time, the Loch Lomond Facility was operating and supplying water to residents on the eastern side of Saint John.

Since the facility has gone into service, ongoing testing by the provincial departments of health and environment and local government monitoring confirms the system is providing the highest quality water for the area. As the facility was being brought online, the pH level was gradually adjusted and orthophosphate was introduced to prohibit corrosion.

The facility is capable of producing up to 75 million litres of clean drinking water per day. A 33 million-litre storage system, anchored by three 11 million-litre Aquastore® tanks was constructed by Greatario Engineered Storage Systems, for the Loch Lomond Drinking Water Treatment Facility.

“Since this was a design-build-operate project, we had a lot of discussion about how to spec the tanks to get the greatest return on investment and security of

supply,” Price said about the choice in storage systems. “The investors wanted a storage solution that would be low maintenance for the 30 years that they’re operating the facility.”

The tanks are known for their adaptability and can be expanded to accommodate future flow or capacity requirements by adding additional panels. Owners consistently comment on the ease of connecting pipes and attaching launders, weirs and other components.

In conjunction with engineers from Wood PLC, the team designed the storage tanks to optimize performance. Consideration of the tank dimensions and additional accessories, as well as tank layout and positioning, helped during this part of the design phase.

“We set the reservoir bottom plate elevations, spaced the tanks to accommodate the inlet/outlet piping and set tank dimensions to achieve the required storage volumes,” says Brandon Turcotte, senior program manager at Wood. “As a result, three tanks were required rather than four, less

bedrock excavation was needed, and the tank footprint was optimized.”

Storage tank footprint is often a significant consideration for utility operators, especially when space is limited. While construction of concrete and steel tanks often requires cranes and heavy equipment, Greatario-built tanks utilize a series of mechanical jacks that take up very little space.

Tanks are built from the top down on the ground. The top ring of panels is assembled first, then lifted to make room for the next ring, and so on. Heavy machinery and cranes aren’t necessary, even when building tanks to store 11 million litres of water. The glass-fused-to-steel tanks met technical specifications for longevity, size, liquid level capability, and height requirements.

The project gained attention around the country because of its unique funding source and the sheer scope of the undertaking. In 2017, it was recognized for its innovation and excellence with the Silver Award from the Canadian

Council for Public-Private Partnerships. Then in 2018, it was awarded “Project of the Year” by the Atlantic Canada Water & Wastewater Association.

More recently, some residents on the west side of Saint John were brought online with the new Loch Lomond facility. Previously, they were serviced by the South Bay Wellfield. There, three large wells had been drilled and pumped water to a local treatment plant. Due to the depth of the wells, the water quality was naturally filtered and required little processing before delivery.

However, a lower than expected yield at the wellfield had caused the water level to drop below the nearby Bay of Fundy sea level, allowing seawater to seep in and contaminate the supply.

The switch has been successful in proving the new facility and increased storage can support additional demand. ■

Jessica Gregory is with Greatario Engineered Storage Systems. Email: jgregory@greatario.com

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NEW TECH HELPS MANAGE FOG AT COLLECTION AND FOOD PRODUCTION SITES

By **Brian Levine**

Grease is not a new challenge for the municipal wastewater industry, but it is becoming increasingly problematic. Annually, there are thousands of sanitary sewer overflows, with fats, oils and grease (FOG) often being a contributing factor.

FOG is the byproduct of cooking with animal fats and vegetable oils. The largest source of grease comes from restaurants, commercial kitchens and industrial food processing facilities. Although food service and food processing establishments are expected to follow strict guidelines for grease trap waste disposal, grease traps can be quickly overwhelmed if not regularly maintained. This allows FOG to enter sewer lines where it cools and solidifies. Over time, the accumulated FOG can block pipes completely, causing backups.

It has been estimated that grease trap waste and uncollected grease entering sewage treatment plants ranges from 365 kg to 7,700 kg of grease per restaurant,



Restaurant and food processing grease traps can be quickly overwhelmed if not regularly maintained. Credit: antpkr, AdobeStock

per year. In response, municipalities continue to adopt more stringent regulations, detailing how food preparation and food processing businesses handle and dispose of grease.

The current COVID-19 world health crisis is further complicating the FOG problem for municipalities. With the vast majority of people under “stay at home” directives and an increased reliance on take-out, prepared foods and home cooking, residential FOG is on the rise, contributing to costly and inconvenient sewer backups. Municipalities spend considerable monies annually to unclog sewer pipes

and repair sewer lines and other damage caused by improper disposal of FOG.

WHAT CAN BE DONE WITH FOG?

Grease trap waste is usually transported to receiving stations at select municipal sewage or commercial wastewater treatment plants where haulers pay fees to dump their loads. However, there is a dire shortage of FOG processing solutions and centres and this limits disposal options.

Downey Ridge Environmental Company developed Greasezilla, a hydronic thermal separation and conversion technology, to manage FOG at collection

Building Better Communities



Bioengineered erosion and drainage controls restore ecological resilience after wildfire, Regional Municipality of Wood Buffalo

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sites and large-scale food production facilities where high volumes of FOG are generated. The patented separation technology removes nearly all grease at the front end without the need for polymers, flocculants or landfilling.

The Greasezilla system heats the grease trap waste, separating it into three distinct layers: residual pasteurized effluent, batter and rich brown grease. The batter can be used as a feedstock for anaerobic digesters or treated with traditional processes. Brown grease is pumped into holding tanks.

Annually, a standard system permits a site to process up to 30 million litres of grease trap waste, while producing a premium, low moisture, high FFA brown grease (advanced biofuel) offtake. This advanced biofuel is a drop-in substitute for No. 5 and No. 6 fuel oil, or Bunker C fuel.

Greasezilla's entire FOG separation process is powered by the same rich brown grease harvested, making it an economically and environmentally sustainable system. Five percent of the biofuel produced by the Greasezilla is required to run the system, leaving 95% available for resale in the commodities marketplace. Not only does the system provide a solution for grease trap waste, but it also reclaims a fuel that burns much cleaner than fossil fuels.

Greasezilla allows publicly owned treatment works (POTWs) to accept grease trap waste from haulers, encouraging grease trap maintenance, generating tipping fees and lowering costs for haulers. Separating FOG upstream of wastewater treatment facilities complies with pretreatment standards for POTWs. These measures strive to prevent pollutants from causing obstructions and other operational interference in POTWs.

UTILITIES OF THE FUTURE

There has been a transformation in the way traditional wastewater utilities view themselves and manage their operations. They are starting to move beyond mere compliance and to consider innovative approaches that focus on efficiency, sustainability, best practices and resource recovery. A growing number of municipalities are incorporating technologies like Greasezilla into their wastewater management processes.

At one wastewater treatment facility, the system processes up to 152,000 litres of grease trap waste per day and is scalable to handle larger flows should the plant be expanded. Including a process like Greasezilla that converts a nuisance waste, like grease, into a commodity grade product appeals to wastewater treatment facilities as it is cost-effective and ecologically friendly. It helps facilities offset a portion of operational costs, while reclaiming a carbon neutral fuel source that can reduce consumption of fossil fuels.

The greatest advantage of hydronic thermal separation technology is that it extends beyond POTWs. Any sites that collect or generate high volumes of FOG, from waste haulers to large food processors, can reap the same benefits of the system. Changing FOG processing from a problem into a global solution will ultimately help our communities, our municipal infrastructures, public health and the environment. ■

Brian Levine is with Downey Ridge Environmental. Email: brian@greasezilla.com

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URBAN STORMWATER RUNOFF CAN ADD SIGNIFICANTLY TO PHOSPHORUS, HEAVY METALS AND OTHER POLLUTANT LOADINGS

By **Stephen Braun**

Non-point source pollutants are a big problem, with urban stormwater runoff playing a significant role in adding phosphorus, heavy metals and other pollutant loadings to our receiving waters. For example, in the Lake Simcoe watershed in Ontario, over 30% of phosphorus loadings to the lake are now identified as coming from urban stormwater sources. Less than 3% of total loadings are coming from water pollution control plants.

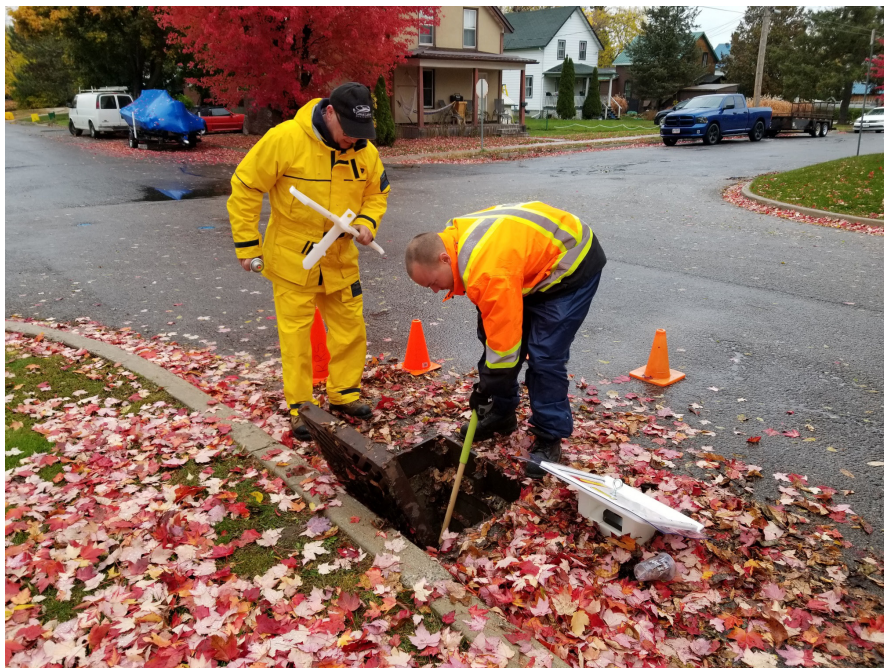
A re-adjusted focus towards stormwater treatment will go beyond the Lake Simcoe watershed if the costs of marginal performance increases at water pollution control plants exceed the costs of treatment of stormwater on a total pollutant loadings basis.

In any case, it is certain that low impact development (LID)-type stormwater approaches and green infrastructure designs need to be implemented on a broad scale. They will go a long way towards addressing stormwater runoff pollutants in new development areas and in retrofit situations.

As well, retrofits of older stormwater management facilities to bring them up to state of the art, will ensure their better success at removing sediment and the attached/adhered pollutants which are the real target. But, in large urban areas built prior to any stormwater management controls, retrofits for stormwater quality can often remain problematic and expensive.

Fortunately, another “almost non-point” treatment option is available for urban areas. This involves retrofitting existing catch basins to provide reliable stormwater treatment.

Transforming catch basins into effective stormwater treatment devices has been an idea with some staying power,



On average, there is approximately one catch basin for every 15 people who live in an urban area in Canada. Retrofit devices can help address stormwater runoff challenges.

and interest in retrofits is once again seeing a big resurgence. However, catch basin retrofit ideas can also irk municipal maintenance departments, which are tasked with taking care of the various next “great” ideas. This means that retrofits must perform to their stated objectives and must be worth any extra effort required.

One of the newer types of catch basin retrofit inserts available in the past few years has already seen over a thousand installations in over 20 Ontario municipalities. It will soon be used in Alberta and elsewhere.

The CB Shield® is a patented Canadian product, manufactured in two locations in Ontario. The company supports stormwater plans with engineered designs, and also arranges for catch basins to be installed with custom field-fitted devices.

The shielding device uses the existing sump of a catch basin to capture and store pollutant-laden sediment. It has a simple fibre-reinforced plastic construction, along with stainless steel riveting and hinges, making it extremely strong and durable. Its lightweight construction (<8 kg per part) allows for quick removal and replacement during maintenance periods.

The CB Shield acts like a seatbelt for catch basin sediments. The “crashes” that the shield protects from are high intensity rainfall events that would otherwise scour out the contents of an unprotected catch basin sump.

Laboratory testing of shielded and unshielded catch basins indicates that both can capture sediment, albeit the shielded one a little more efficiently. But without a shield, a catch basin is terri-

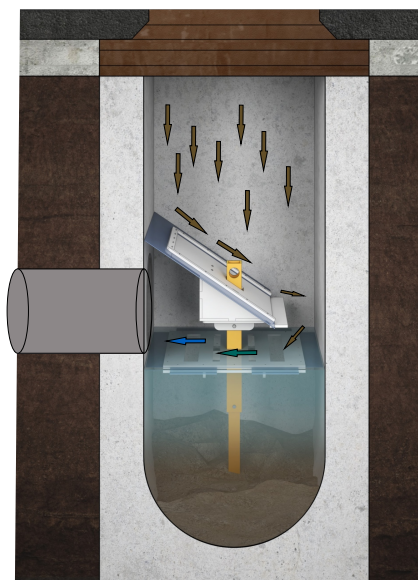
ble at keeping its sediment under higher flow conditions, which scour out everything it might have caught. Field testing indicates similar results. Accordingly, the catch basin shielding device is seen also as a hedge against future climate change, where we will most likely see increases in high intensity rainfall events.

The value proposition of retrofitting catch basins for reliable stormwater quality treatment is fairly clear, especially for older urban areas where no other stormwater management is in place:

- 50% – 60% reliable long-term sediment capture (per Environmental Technology Verification test sediment particle size distribution).
- No digging up streets, no construction impacts, just quick and customized installation.
- Additional easement and/or purchase of land not required for stormwater management.
- A stormwater quality control system that spreads out risk, as a failure at one or a few locations is not significant.
- Utilizing a maintenance system that is typically already in place, and extending the time between maintenance periods (thereby reducing costs).
- Keeping sediment from downstream areas, where removal is more expensive.
- Cleaner watercourses and lakes receiving stormwater runoff.

Many cost comparisons have been completed for existing urban areas. All indicate that the implementation cost for a catch basin retrofit program is typically an order of magnitude less expensive than other stormwater management approaches. Catch basin retrofits are simpler and less intrusive. They can quickly transform older existing urban areas to ensure downstream sediment and pollutant loadings are reliably reduced.

Interestingly, many CB Shield devices have also been installed at “greenfield” or new development areas. Catch basin sumps in Ontario (Ontario Provincial Standard Drawing – OPSD 705.010) store approximately 0.2 m³ or 300 kg of sediment. This weight of sediment takes approximately three years to accumulate in the sump under average conditions prior to maintenance. This is often an extra year beyond a typical two-year catch basin maintenance cycle.



The CB Shield device uses the existing sump of a catch basin to capture and store pollutant-laden sediment.

The large accumulated mass of sediment also indicates why the approach of storing sediment in the sump for typical vacuum truck cleaning is preferable to lifting top-mounted “hanging bag” devices. In any case, keeping sediment from being transported to downstream areas results in significant operational cost savings. Sediment removal from pipes and ponds is usually many times more expensive than the cost of cleaning it at a catch basin.

Similarly, protecting catch basins with shields can provide a very effective pre-treatment function prior to runoff being discharged to an LID-type or green infrastructure system. The City of Kitchener, Ontario has performance specifications for enhanced catch basin devices being in place to pre-treat runoff prior to discharge to its infiltration systems. The CB Shield insert satisfies its current requirements.

Maintenance of a CB Shield protected catch basin isn’t much different than a regular catch basin, and will, on average, add one more minute of labour per catch basin cleaning. Device removal takes approximately 10 to 30 seconds, with the catch basin then cleaned by vacuum truck in the same fashion it would have been cleaned. This is followed by replacement of the device (another 10 to 30 seconds).

A significant number of these catch basin inserts have now finished their

fifth winter season and no extra maintenance has been reported. This is due to the inserts being specifically designed to ensure flow blockage potential would not be increased, and to laboratory testing under very high flow conditions (> 70 L/s).

Suitable testing of any stormwater device, including a catch basin retrofit device, is critical to knowing its true performance capabilities. As well, verification of performance under controlled laboratory conditions must be completed by an accredited third party in order to have value. In the case of the CB Shield device, a protocol was developed by a third-party lab which closely followed Environmental Technology Verification (ETV) Canada’s *Procedure for Laboratory Testing of Oil Grit Separators* (TRCA, 2014).

Results from the testing allowed verification to be completed according to ETV/ISO 14034:2016 criteria, and posting of testing results has been made available on the ETV Canada website.

Approval agencies and municipalities, including their maintenance departments who are responsible for the devices, will also want to see some field testing results from field pilot studies or larger installations. As well as confirming general performance characteristics, field testing also indicates a catch basin device’s ability to withstand harsh winter conditions, and demonstrates ease of maintenance.

On average, there is approximately one catch basin for every 15 people who live in an urban area in Canada. Catch basin retrofit devices are part of the answer for addressing our urban stormwater runoff challenges, either as pre-treatment to LID and green infrastructure, or as establishing a minimum basic water quality level in otherwise hard to treat areas.

The preservation and enhancement of aquatic life, which includes swimming at the beaches or paddling in our canoes, depends much on the quality of our stormwater runoff. We may be able to treat our own drinking water and even fill a pool, but you can’t really treat a river, never mind a Great Lake. ■

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GLOBAL WATER FUTURES HOSTS PANEL TO DISCUSS CREATION OF CANADA WATER AGENCY

Many leading water experts currently see Canada at a crossroads in the emerging water-climate crisis and believe that the creation of a Canada Water Agency could deliver water security if collaboration could exist alongside a common vision for the future.

Global Water Futures, a University of Saskatchewan research program designed to chart a path forward for Canada's water-related challenges, hosted a May 13 expert panel discussion online to consider the benefits and challenges of creating a national water agency that would leave the status quo far behind.

A mandate for the creation of the agency has already occurred within the federal government, and many of the panelists agreed that the agency should be created in tandem with modernizing Canada's outdated water legislation. The *Canada Water Act* has not been modernized since it was passed in 1970.

Terry Duguid, MP and Parliamentary Secretary to the Minister of Environment and Climate Change Canada, described these opportunities to rise to water-climate challenges as a "once in a generation opportunity."

"Water governance, water management, water cooperation is not easy," Duguid told the panelists and webinar audience. "It's a mandate, a commitment, and an important one. But we are moving forward," he added.

Global Water Futures has released a white paper on water security that suggests the emerging water crisis consists of three primary issues: inadequate source water management that is undermining public confidence in the provision of basic human rights; degraded water quality and habitat loss that is undermining the ecological integrity of waters; and lastly, intensifying floods and droughts that are escalating the costs to the Canadian economy.

Global Water Futures has recommended that the Canada Water Agency should be anchored by two major units

Canada's Emerging Water Crisis

Canadians can no longer assume our waters are boundless, safe and secure:



Intensifying floods and droughts are escalating the costs to the Canadian economy:

We estimate that a staggering \$28B has already been spent responding to and repairing the impacts of climate-related water disasters between 2000 and 2017. This financial burden is spread unevenly and is unsustainable for many Canadians, and is expected to grow rapidly.



Degraded water quality and habitat loss is undermining the ecological integrity of our waters:

Toxic algae blooms in some of our largest fresh water lakes and development pressures infringing on preserves and parks are threatening our ability to use our waterways for recreation and fisheries, endangering important species and undermining our efforts to maintain protected areas.



Inadequate source water management is undermining public confidence in provision of basic human rights:

Lack of a coordinated approach to water management is denying access to safe drinking water, particularly for many First Nations and other communities vulnerable to source water contamination.

Canada's emerging water crisis. Global Water Futures

from Environment and Climate Change Canada: the National Hydrological Service (NHS) and the Water Science and Technology Directorate (WST). In addition to the NHS and WST, a cross-departmental review will identify key water units from Agriculture and Agri-Food Canada, Fisheries and Oceans Canada, Natural Resources Canada, and other federal departments that should be brought together under the new agency.

Shawn Marshall, a departmental science advisor with Environment and Climate Change Canada, noted that in order for the agency to get off the ground, a lot of coordination will be required at the federal level.

In agreement with all panelists, Sandra Cooke, director of the Canadian Municipal Water Consortium, said that collaboration will be key, but that the mission will need a framing and a set of guiding principles around that collaboration.

Panelist Merrell-Ann Phare, the executive director of the Centre for Indigenous Environmental Resources, said that establishing a Canada Water Agency could be critical for integrating Indigenous world visions and providing tools to fully resolve outstanding First Nations water issues.

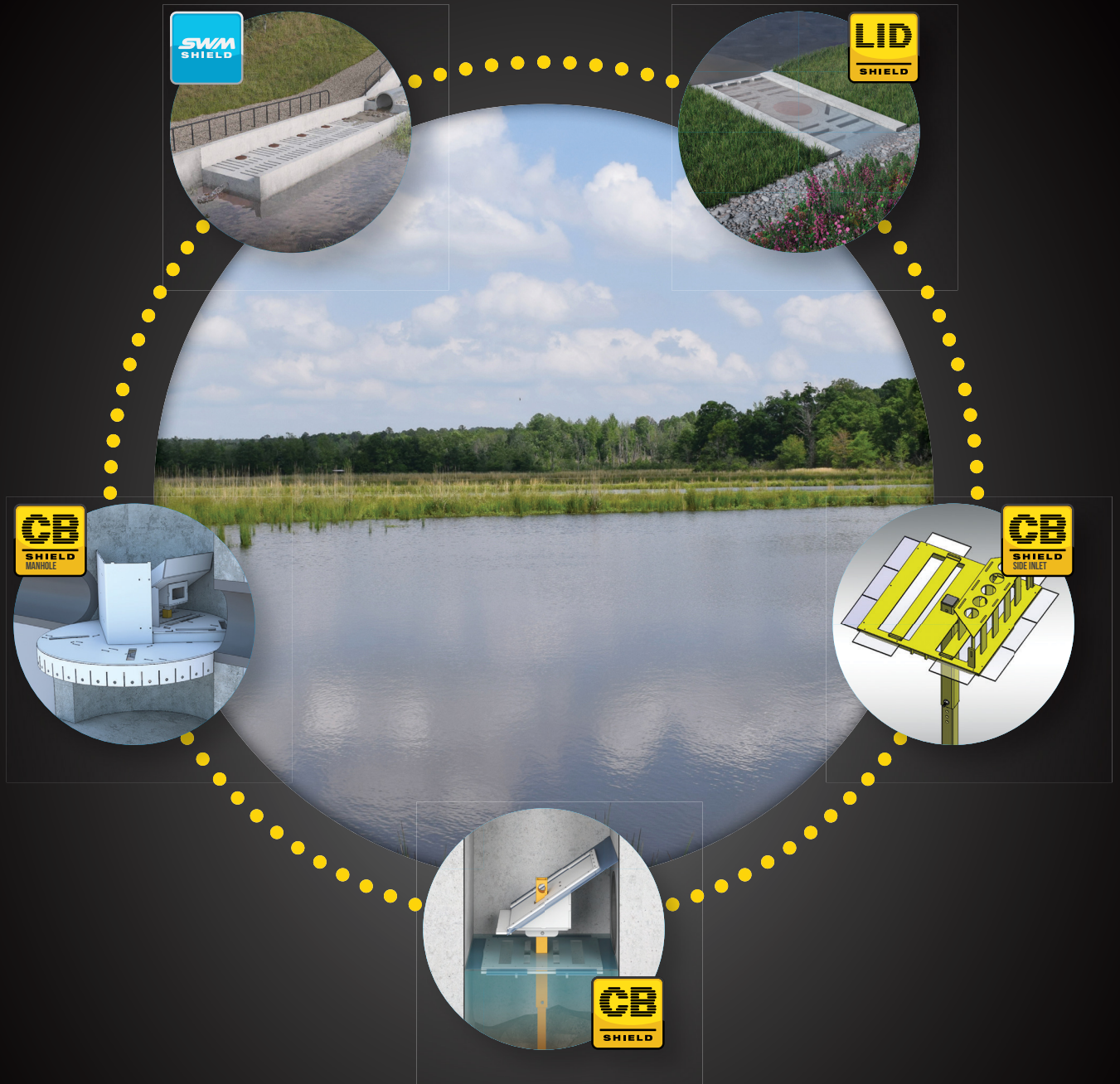
Dimple Roy, director of water manage-

ment for the International Institute for Sustainable Development, told the panel that "data scarcity is one of the most critical issues we have," and hoped that a new Canada Water Agency could go a long way towards closing some data gaps. She praised the work of The Gordon Foundation in creating a new open-access online hub that allows people to find freshwater data and track changes to Lake Winnipeg's health. ■

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Flowerpot Island in Lake Huron. This Great Lake has four areas of concern that require remedial action. Credit: Ravi, AdobeStock

BILLIONS SPENT ON GREAT LAKES RESTORATION MAKING PROGRESS ON AREAS OF CONCERNS

A new study of pollution prevention for the Great Lakes found that an estimated \$22.7 billion has been spent between 1985 and 2019 on the cleanup and restoration of all U.S. and Canadian areas of concern (AOCs).

The *Journal of Great Lakes Research* study, entitled “Thirty-five years of restoring Great Lakes Areas of Concern: Gradual progress, hopeful future,” states that every dollar toward Great Lakes cleanup has led to more than \$3 worth of community revitalization. However, substantial and dedicated funding for remedial action was not provided in the U.S. until the enactment of the *Great Lakes Legacy Act* in 2002 and the establishment of the Great Lakes Restoration Initiative in 2010.

“Pollution prevention investments should be viewed as spending to avoid future cleanups,” states the study, which includes McMaster University’s Gail Krantzberg in Hamilton, Ontario.

Krantzberg, an engineering professor specializing in Great Lakes science, policy and governance, as well as fellow

researchers John Hartig and Peter Alsip, state within the study that the industrial revolution not only helped establish and expand Great Lakes cities through industries built around mining, steel, lumber, automotive, chemical, energy, shipbuilding and grain, but also left a legacy of environmental pollution that is now clearly evident in 43 AOCs.

“There is no doubt that the industrial revolution left a legacy of unchecked water pollution, loss and degradation of habitats, and contamination across the Great Lakes,” the study states.

Since 2010, the Great Lakes Restoration Initiative (GLRI) has provided over \$650 million for restoring AOCs. Since 1985, seven AOCs have been delisted, two have been designated as areas of concern in recovery, and 10 have implemented all identified remedial actions and monitoring is underway to confirm use restoration. In addition, 79 of 137 known use impairments identified in Canadian AOCs (58%) and 90 of 255 known use impairments in U.S. AOCs (35%) have

been eliminated as of 2019.

For example, in Toronto, the study found that decades of cleanup under remedial action plans (RAPs) have led to the revitalization of Toronto’s waterfront with substantial economic and social benefits, including \$4.1 billion in output to the Canadian economy. In Hamilton Harbour, too, funds contributed to a massive contaminated sediment remediation project at a cost of \$140 million.

The new Great Lakes research traces the history of the Great Lakes RAP program from its 1985 origin in a recommendation of the International Joint Commission’s Great Lakes Water Quality Board and identifies what has been accomplished and learned over the last 35 years.

Paul Sibley, president of the International Association for Great Lakes Research, says the new study shows how a strong foundation of federal environmental laws through the U.S. Environmental Protection Agency’s Great Lakes National Program Office and Environment and Climate Change Canada, can make a difference.

Sibley added that federal legislation combined with locally led cleanup processes can achieve restoration of the most polluted areas of the Great Lakes and inspire waterfront community revitalization.

“Lessons learned from this research will be helpful to all groups working to clean up polluted waterways and revitalize communities,” Sibley said in a water research post from McMaster University.

Based on the findings of the Great Lakes study, it is recommended that the U.S. and Canada consider investments in pollution prevention programs (consistent with the Canada-U.S. Great Lakes Water Quality Agreement goals of zero discharge and virtual elimination of persistent toxic substances). These would include design for the environment and a circular economy that eliminates waste and ensures the continual use of resources, as spending to avoid future cleanups of the Great Lakes. ■

REDUCING THE ENVIRONMENTAL IMPACTS OF INDUSTRIAL COOLING WATER DISCHARGES

By James Green

According to the United Nations, 20% of all water use in the world is for industrial processes. In industrialized nations, this number can increase to as high as 80%. A significant portion of that water is used for cooling operations where once-through systems and cooling towers utilize it to cool critical processes such as power plant condensers, oil refinery and chemical plant systems, and HVAC/comfort cooling systems.

With the demand for water accelerating globally, especially for power generation, significant emphasis has been placed on developing technologies to reduce water use and improve the recycling of water resources. While significant progress has been made, there have been limited advancements in technologies that reduce the environmental impact of concentrated discharge water streams that upset the delicate balance of nutrients in the environments downstream of industrial processes.

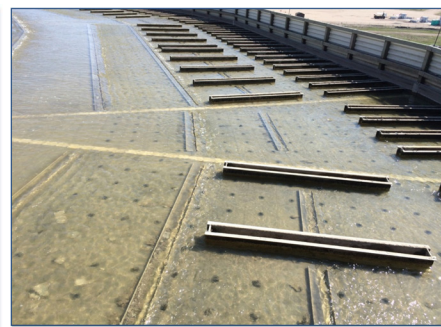
New research methods utilized over the last 10 years have resulted in a novel understanding of chemistry in cooling water systems and advancements in chemical design. This new understanding of engineering passivation films in aqueous systems allows companies to eliminate the use of excess nutrients, such as phosphate, heavy metals, such as zinc, and hazardous acid usage. In addition, this can improve operator safety, increase production rates and the reuse of water in cooling systems.

Since the regulation and elimination of hexavalent chromium-based cooling water treatment, the industry has relied on the use of phosphate-based technology for deposition and corrosion inhibition in cooling water systems. In various forms, these phosphate-based molecules protect the operating assets of production facilities from failure, while enabling those facilities to reduce water usage by 75% – 90%.

Still, phosphate-based technology comes



Phosphate-based cooling water treatment program



Non-phosphate-based cooling water treatment program

Compare a phosphate-based cooling water treatment program to a non-phosphate based program. Challenges with algae growth and control disappear.

with its own set of challenges. Without the addition of advanced polymer dispersants, these materials can cause the failure of production assets through deposition, flow restriction and under-deposit corrosion. Significant improvements have been made in these polymers, including the development of dedicated terpolymer dispersants, like the industry-leading stress tolerant polymer (STP) technology.

This technology, in combination with polymers like alkaline enhanced chemistry (AEC), leads the way in reducing phosphate levels, in some cases up to 60%. Still, even the small amount of remaining phosphate in concentrated cooling water discharge streams can become an issue.

In addition to the challenges with deposition control, phosphate can have a significant impact on downstream environments and ecology. Phosphate is a limiting nutrient in biological growth, such that any excess phosphate in the water can result in additional growth of biological organisms that wouldn't have grown if the phosphate wasn't present.

One of the most challenging issues highlighted currently in the Great Lakes area is excessive algae growth due to the presence of excess phosphate. Algae can be harmful to other organisms and neg-

atively impact the surrounding ecology. It has been found that one pound of phosphorus can generate up to 230 kg of wet algae. That algae growth can directly impact the ability of a production plant to clean up its water prior to discharge into the environment, resulting in fines and potential loss of production.

With such a significant impact on the environment, regulating authorities are currently, or in the process of, restricting the phosphorus discharge limits from facilities. These discharge levels are so low that the use of phosphate-based materials in cooling water systems are ineffective and cannot achieve the desired performance.

To support the changing needs of the industry and the desire to remove phosphorus from cooling water systems in an effort to improve deposition issues, reduce algae and discharge issues, and improve the environmental profile, water treatment companies have been pursuing and introducing non-phosphorus solutions. There are a few different approaches with varying benefits that can be applied to meet phosphorus discharge restrictions.

The most common approach is to utilize zinc in combination with a carboxylic acid polymer to eliminate the need

continued overleaf...

to use phosphorus. Initially used over 30 years ago, zinc is a well-known and commonly used corrosion inhibitor. Unfortunately, zinc can also cause deposition issues and is a priority pollutant that is deemed harmful to the environment. Overall, this approach works well but has significant environmental drawbacks.

In the last few years, it has become common for many companies to utilize stannous chloride (tin) in combination with a polyaspartic, glucaric or saccharic type acid. Typically fed at 2 – 3 times the levels required for zinc, at significantly higher cost, tin can provide an improvement in corrosion control versus an untreated system, but only in waters that do not have an oxidizer like hypochlorite or bromine present.

These oxidizers are commonly fed continuously to cooling water systems to control biological growth. Tin materials have multiple oxidation states and in a cooling water system where oxidizers are present, the tin is quickly oxidized to an insoluble form and proceeds to precipitate in the bulk water, rendering it useless for corrosion control. In addition, tin has a solubility product constant similar to that of calcium phosphate salts, meaning it can cause deposition and failures, just like a phosphate-based material.

The final issue for tin materials is that they can cause direct, galvanic corrosion to occur in production assets like heat exchangers. Many companies have attempted to use carboxylic acids to sequester the tin and keep it soluble, which works well in a neat, formulated chemical product.

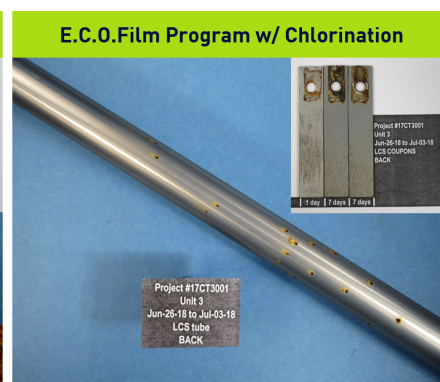
Still, upon introducing the product to the cooling water system, the carboxylic acid releases the tin, where it is affected by oxidizers and system metals.

So how can companies meet their sustainability and environmental goals with a cost-effective solution? By using new technologies based on engineered films.

Instead of trying to develop anodic or cathodic corrosion inhibitors to control a corrosion cell effectively, a team at SUEZ redefined the known mechanisms for corrosion control. By leveraging a series of techniques to understand every layer of a corrosion-inhibiting passivation film (<150 nm thick) on a metal



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Tin vs E.C.O. Film performance.

surface, the team spent 15 years developing methods and chemistries to engineer a robust, protective film in an aqueous solution, that doesn't inhibit heat transfer, and is thinner than previous phosphate-based technology.

SUEZ's E.C.O. (engineered carboxylate oxide) Film technology allows customers to meet or exceed changing environmental regulations and take significant steps towards reaching their sustainability goals.

While it may contain trace amounts, this non-phosphorus technology helps to reduce toxicity to aquatic life, minimize harmful algae growth and algae blooms and increase water reuse.

It also delivers the same performance and protection standards that cooling water system operators have come to expect from traditional chemistries.

E.C.O. Film uses polymeric technology based solely on carbon, hydrogen and oxygen (CHO) containing polymers. In a cooling water system, the CHO technology primes the metal surface and aids in promoting a passivated metal oxide layer before helping to protect the metal oxide with a protective, dynamic, heterogeneous capping matrix layer.

The film formation takes minutes to hours, not days or weeks, and is self-limiting in thickness. This means that the protective film will never grow to a point where deposition could cause production problems. Instead, it stays 20 – 50 nm thick. In some applications, a patented

surface film formation catalyst (SFFC) is used to enhance corrosion protection.

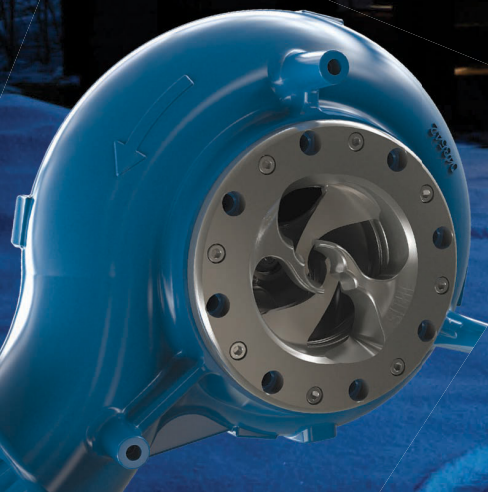
This catalyst targets only the metal surface (it's not found in the capping matrix) and helps to develop a stronger passivated metal-oxide layer in corrosive water conditions. Typically fed at 92% lower levels than zinc, and 96% lower levels than tin, the SFFC is an excellent choice for a non-phosphorus, environmentally conscious approach to treatment.

In some applications, it has been documented that asset life (time to failure) can be 10 – 20 times longer due to the improved corrosion protection of E.C.O. Film. Unlike tin technology, it is 100% halogen/oxidizer stable, so regardless of how much hypochlorite or oxidizer is fed to control biological growth, it will continue to work and provide protection against harmful corrosion and deposition.

This technology allows production facilities to minimize phosphorus contributions to outfalls, which, in turn, prevents harmful algae growth and detrimental eutrophication of freshwater resources. It can help facilities meet or exceed new and changing phosphorus discharge regulations and can prevent costly deposition associated with phosphate-based materials. ■

James Green is with SUEZ – Water Technologies & Solutions. Email: james.green@suez.com

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WASTEWATER DISTRICT DIGITIZES ITS SYSTEM INSPECTION WORKFLOW AND DESIGN

By **Sean King**

The Clark Regional Wastewater District in Washington state supplies wastewater services to approximately 40,000 Equivalent Residential Units (ERUs) over an area of more than 122 square kilometres.

The district's engineering department maintains full geographic information system (GIS) service for the sanitary sewer services across the area. One of the primary services the department provides includes field service technicians that perform on-site inspections for new system connections and new construction of sewer infrastructure.

The district currently adds the equivalent of 1,800 new single-family home connections (ERUs) to its infrastructure every year. They also have over 200 development projects ongoing in various states of review and construction, and 55 active capital projects.

THE CHALLENGE

Robin Krause, former district engineer, summarized the challenge as "the need to accomplish more with the same number of staff, while doing it more effectively and with greater career satisfaction. The field staff knew they could be more effective with the right tools."

Previously, when a construction project required a new or altered sewer connection, contractors would contact the district to request a site inspection by telephone or email on an ad hoc basis. Once these requests were received, administrators would generate various paper forms that waited to be picked up by an available inspector.

The ad hoc nature of the requests, coupled with human error when submitting an inspection request, meant that around 20% of the time there would be missing or incorrect information that district employees would need to have verified before work could proceed.

"A good 20% of the time some informa-



The district's engineering department maintains full geographic information system service for the sanitary sewer services across the area.

tion was wrong, so the inspector would have to call the contractor, find out what the real information was, and then go from there," says Tom Sedlacek, senior engineering technician (GIS) for Clark Regional Wastewater District.

Inspections took place by recording test results and creating field sketches by hand with pen on scratch paper. After the inspection was carried out, sketches were brought back to the office and transferred again by hand to the inspection form. The forms were then scanned and processed. As inspections take place in all weather conditions, further data accuracy challenges occurred when transcrib-

ing data from documents that had been filled out in wet conditions, and correctly associating the sketch with the correct inspection.

With paper forms, there was no centralized database and information was stored in multiple systems. Emails and meetings were required to track the status of a given inspection or project, which was time-consuming and also lent itself to accidental data duplication.

THE SOLUTION

Realizing that they were not taking full advantage of new technologies, the district began working with FLO Analytics

to analyze their requirements. Together, they realized they had an opportunity to digitize the district's inspection workflow and design better ways of doing things.

These new processes required the ability to tie mobile data collection apps directly to GIS software, while ensuring field data remained tied to the asset throughout the inspection and review life cycle. Another requirement was for better visibility into real-time data with a centralized database and dashboard reporting capabilities. After FLO Analytics conducted a thorough evaluation of the options available, Flowfinity was selected, due to its versatile platform.

"One of our first tasks was to find a good field form app; we wanted to keep our systems as GIS-centric as possible," said Sedlacek. "Other Esri compatible solutions that were Excel based didn't really lend themselves to the dynamic data that we needed. Flowfinity is SQL based and provides a much more dynamic central database."

DISPATCH AND DATA COLLECTION

With Flowfinity, field data collection

apps have streamlined site inspection workflows significantly. Paper forms are no longer required, as data collection is now digitized and performed using apps that guide an inspector through all required steps of an inspection. This has greatly reduced the per-inspection time and human error.

Contractors and members of the public now primarily request permit inspections online, where all relevant data is collected and system integration is instantly stored within Flowfinity. Staff can access permit requests and information on the map and launch an inspection record directly. Submitted data updates the map in real time in the field and office, providing a single view of inspections. Automatic email notifications send copies of project inspections directly to contractors and other parties, improving communications and saving time.

"When we get a new permit in, it goes directly into Flowfinity, it is matched to a GIS polygon and placed on our map, and once it's completed the polygon will be automatically removed from the map," said Sedlacek.

On-site photos are taken using an inspector's mobile device and are immediately stored in Flowfinity. They can be annotated in the app, instantly highlighting special instructions or concerns while high precision GPS locations are taken with a commercial antenna. This means scanning and deciphering hand drawn field diagrams is a thing of the past.

GIS MAPPING

FLO Analytics helped the district with coding integrations that allow the sharing of permit inspection data stored in their new system with Esri ArcGIS mapping software. This means that data collected in the field is tied to GIS maps and vice-versa. A field inspector can identify the location of an asset location via a GIS map polygon, then launch an inspection in Flowfinity with a tap.

"Flowfinity's SQL backend allowed us to develop innovative data integrations directly with the Enterprise GIS system, allowing for easy map display and interactions," says Grant Herbert of FLO Analytics.

This integration not only ties two vital

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systems together in a way that improves user experience, but it also ensures that data integrity is maintained. There is no risk of duplicate inspections or erroneous GIS maps that slow reporting and analysis. The details of an inspection can be viewed in Flowfinity via records, or colored polygons on an area map in ArcGIS.

"I click the job icon on the map, and here's all the information that comes out of our finance software. From the map I click on 'Start Inspection' and it launches Flowfinity," says Sedlacek.

TRACKING AND REPORTING

All field data collected is stored instantly in a centralized, dynamic database. If there is no internet connectivity on-site, data will be stored on the device and uploaded when a connection is available, providing reliable offline functionality when needed.

This combination of mobile data collection apps and centralized database provides real-time visibility across the organization. When an inspection is submit-

ted from the field, it is instantly accessible for review by office-based admin staff. No more waiting for paper forms to return.

Daily reports are automatically generated and distributed, summarizing the previous days' inspections, which can also be easily visualized in real time on a digital map. This replaced the need for time-consuming meetings and email correspondence to track progress.

RESULTS

The district considers their digitization project a success as they enjoy significantly increased efficiency and timesaving. In the first year, 373 hours of labour were saved, primarily in data entry and record keeping, leading to a 60% project cost recovery. Having the ability to immediately access data and track permits has also dramatically decreased response times and resulted in improved customer service.

The department projects a 160% ROI within 5 years. Achieving ROI has taken less time than anticipated, and the ver-

ified timesaving have been further bolstered by a variety of soft ROI factors such as less time spent in status meetings.

NEXT STEPS

The district hopes to leverage dashboard reporting, integrated with GIS, to drive field operations and business performance as the next phase of their Flowfinity app development journey. Future iterations may also incorporate more process automations utilizing software robots to achieve even greater efficiencies.

Flowfinity has recently launched new mapping and integration features and plans IIoT remote sensing functionality that should prove useful to municipalities, utilities, and environmental engineering firms. ■

Sean King is with Flowfinity Wireless Inc. in Vancouver, B.C. Email: sales@flowfinity.com, or visit www.flowfinity.com



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ARE REINFORCED CONCRETE PIPE JOINTS INFILTRATION PROOF?

By **Lui Sammy Wong**

Concrete sanitary sewage networks are part of key infrastructure assets in which larger flow volumes are collected from smaller flexible pipes. Pipelines are made of segmental units and joints are unavoidable. Performance of reinforced concrete pipe (RCP) joints has been challenged by the owners for decades. To a certain extent, the RCP industry is losing the competitive edge to emergent materials.

The Weibull distribution, the “bathtub” curve, is the best illustration of the performance of a pipeline, where the failure rate during the early life of a structure and near the end of a structure are usually substantially higher than during its ser-

vice lifespan (Luko and Neubauer, 2020). This is the reason why CCTV inspection is especially important prior to a pipeline being assumed by a municipality.

Observing leaky joints during inspection is not uncommon and, in some cases, is too frequent and very costly to repair. Contractors rely on their experience to manage infiltration risks. Installation quality can only be revealed after the pipeline is backfilled and put into service. Poor pipe joints were claimed in a recent report to be the main reasons for infiltration (Norton Engineering Inc., 2017).

Infiltration resulting from RCP joint performance is caused by three main reasons: inadequate material specification

requirements in dealing with infiltration; lack of technical knowledge of RCP joint performance; and a disconnected link between installation quality and the joint performance.

Existing RCP specifications do not deal with infiltration at all. RCP carries a gravity flow, so internal hydrostatic pressure is trivial, in comparison to the external pressure when groundwater is present. The hydrostatic test required by CSA A257 requires RCP manufacturers to test three pipes horizontally for an internal pressure reaching 105 kPa, 90 kPa and 35 kPa for 10 minutes, under straight, deflected and offset alignments respectively.

Internal pressure is not nearly equivalent to external pressure (Figure 1) and 10 minutes is too short a time to allow the viscoelastic rubber material to settle in the annular space. In addition, the test is mandatory only for pipe sizes up to and including 900 mm. Canadian standards, in terms of hydrostatic testing, are more stringent than anywhere else in the world (Wong and Nehdi, 2018). However, the methods of testing do not reflect external pressure conditions.

Gasket suppliers also evaluate the sealing pressure of rubber gaskets by plotting their load-deformation behaviours. However, not only is the test being conducted under ideal conditions, it also ignores the frictional effects of the hydrostatic pressure that is perpendicular to the applied loads. The results, in fact, are far from reality.

Research conducted by Western University, and sponsored by Con Cast Pipe, quantifies RCP joint performance for infiltration (Wong et al., 2020). Tests show that existing designs are capable of handling over 600 kPa of pressure externally. Figure 2 shows the test results of two different gasket materials using 10 minutes of sustained external pressure and different joint gaps. These tests demonstrate that the main impact factor is the joint

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gap. By opening the joint from 6 mm to 13 mm, pressure capacity is reduced by half.

The capacity is also influenced by gasket materials, duration and alignment. There are large variations in the test results, and the research also shows that gasket materials require a longer time to settle under sustained pressurized conditions. During these tests a water supply connecting cylinder was used to allow the technician to monitor leaks. Air pressure was introduced into the top of the cylinder during the tests and the water was pushed into the annular space between the pipe samples. If a leak occurs, or the gasket moves, the water level drops, indicating an increase in the annular space. Figure 3 shows water level reduction over 20 hours of sustained external pressure in the cylinder.

A reduction of water level, without observing leaks in the system, indicates that gasket movement is causing an increase in the annular space. Taking the worst test results and the worst testing conditions (large gap), the performance of the existing joint for infiltration still generally exceeds the 105 kPa threshold. Research shows that external pressure tends to push the gasket inward. With the existing design, the gasket can be pushed out of the annular space of the joint when the gap is excessive. Figure 4 shows observations of failures in the infiltration test and in the field. This indicates that joint gaps definitely separate a functional sewer from a failed one.

How can joint gaps be controlled in the field? Contractors often use joint gaps to adjust construction imperfections in alignment. Some contractors will ask for the maximum allowable gap, which by definition is 13 mm, because the existing standard requires a 13 mm gap in the hydrostatic test under deflected alignment.

From a technical standpoint, without considering the site conditions and blindly using the 13 mm maximum gap allowance will lead to costly leak repairs. No technical guidance exists for pipe installations. Existing field inspections are not required until after the completion of the pipeline, which is too late to make easy leak repairs.

In some cases leak-free inspections do not guarantee water tightness, because

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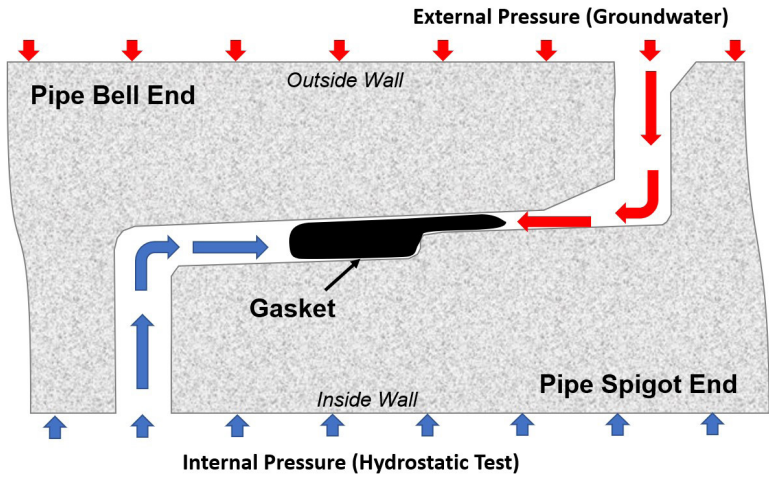


Figure 1: RCP joint subjected to internal and external pressure.

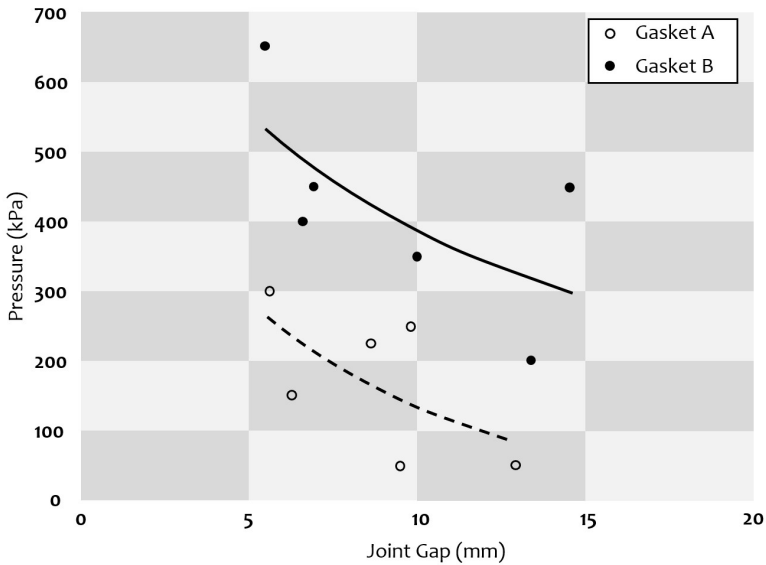


Figure 2: Hydrostatic performance for infiltration on 600 mm RCP joint.

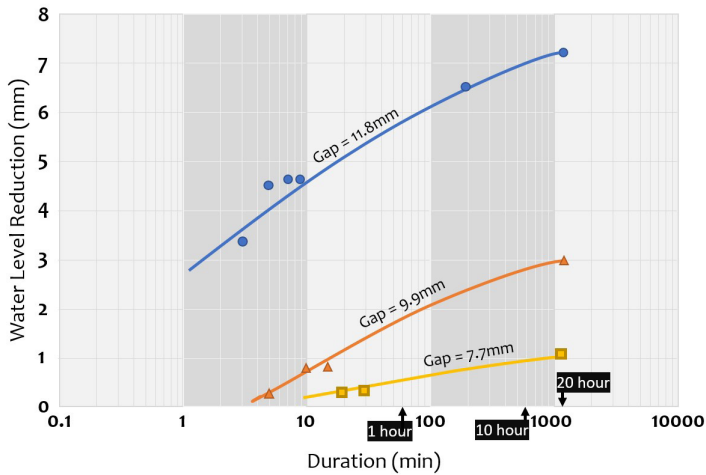


Figure 3: Gasket movement of 900 mm RCP joint subjected to infiltration pressure.

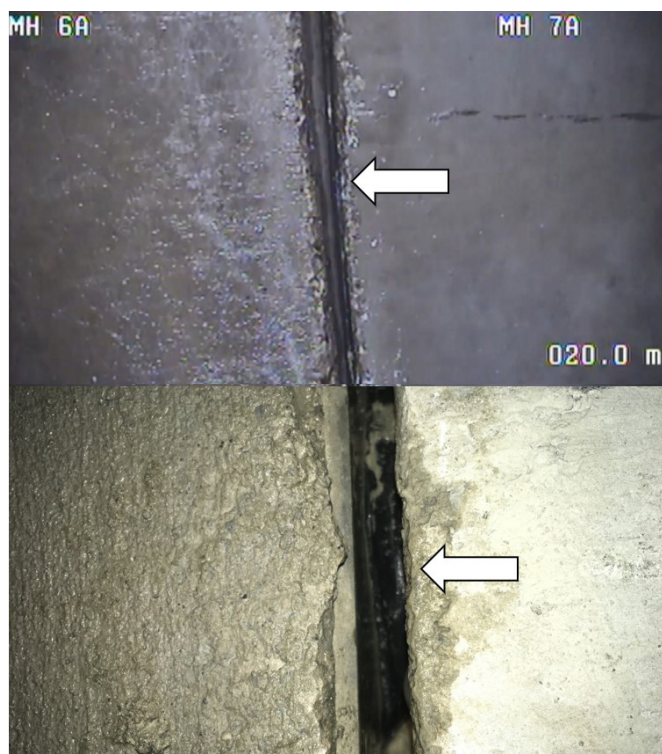



Figure 4: Gasket displacement observed in CCTV inspection (top) and infiltration test (bottom).

these tests rely on external groundwater conditions at the time of the tests. Based on a survey, close to 70% of municipalities in Canada do not conduct these tests. (Norton Engineering Inc., 2017)


Infiltration tests in a laboratory were reported by Fenner (1990), and Moore et al., (2015). The testing methods introduced by Wong and Nedhi (2018) were designed to allow manufacturers to conduct tests in a factory environment. These are done using a vertical setup focusing on joint performance for infiltration (Figure 5).

This test had been conducted over 100 times during a research project, with pipe sizes ranging between 600 mm and 1200 mm. The largest pipe size tested using the same method was 1800 mm. It is easy to set up and the footprint of the equipment is far less than the existing internal test. It is also safe to operate because of the limited amount of water required to fill the annular space. This allows the manufacturer to test to a much higher pressure, i.e., 685 kPa. In the case of 1800 mm pipe, it was set up on a set of bunking wood because the size of the testing base frame was exceeded. However, the testing method was identical to those of smaller sizes. Unlike the conventional test, the method is not limited by pipe size.

The apparatus includes a water cylinder, which allows monitoring and quantifying the leaks during the test. Spacer pads can be used for the test with various joint gaps. In 2019, ASTM C497 included a standard test for infiltration that the owner



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Figure 5: Infiltration test apparatus and setup in a precast factory.

can specify. The RCP industry is now under pressure to adopt the test as a part of routine evaluation for infiltration.

Testing the joint only for infiltration is not sufficient. As discussed earlier, part of the issue occurs in the field. Linking test results to field conditions is key. Performance charts revealing the infiltration capacities under various conditions allows the designer to set boundaries for the installation.

Figure 2 shows a simplified performance chart for 600 mm RCP. If the pipe is subjected to 10 m of hydraulic head after it is put in service, the joints are required to withstand 100 kPa of external sustained pressure.

A safety factor can be introduced to calculate maximum allowable joint gaps during installation. It has to account for all variations and unforeseen circumstances encountered in the field. In this example, using a safety factor of four, joints are required to withstand 400 kPa. 9.5 mm will be the maximum allowable value in the field by the contractor to control the joint gap when Gasket B is being used.

The contractor would be required to meet this limit in order to reduce the risk of infiltration. If an excessive gap is unavoidable, immediate remediation such as patching and external protection would be required to reduce the cost of repairs and the risk of infiltration. These can all be built into the construction specifications.

CONCLUSIONS

Reinforced concrete pipe is proven to be durable. RCP joints have the potential to offer outstanding joint performance for infiltration. However, solutions should be implemented at the early stages of the supply chain by manufacturers, and by designers who are required to consider groundwater conditions when specifying joint performance. Contractors also need technical guidance on joint gaps and the risk of infiltration. ■

Lui Sammy Wong is a PhD candidate in civil engineering at Western University and is with L.S. Wong and Associates Inc. Email: info@wongengineering.ca. Article references are available upon request.

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Site of July 2019 oil spill in northern Alberta.

SURFACTANT-BASED EXTRACTION PRODUCT HELPS MINIMIZE IMPACTS FROM LARGE SPILL IN ALBERTA

By **George (Bud) Ivey** and **Adam Dunn**

In July 2019, a failure of pump equipment led to the spill of about 320,000 litres of a mixture of crude oil and produced water at an oil storage and processing facility located in remote northern Alberta. As the facility operator reported, approximately 99% of the spilled fluids were recovered, having been contained in an on-site bermed area, which already held about 300 m³ of pooled surface water. Some of the product, however, breached the containment area and was released into the local environment.

Calgary-based Earthmaster Environmental Strategies Inc. was retained to assess cleanup options and implement the remedy for cleaning up the spill. They reported that the liquid prod-

uct that breached the containment area had flowed down a relatively steep slope (20% – 30% grade) about 180 m to the south-southwest. It was affecting herbaceous vegetation and associated trees and shrubs along its pathway.

An environmental receptor of concern was a small creek flowing near the base of the slope. Released fluids did not enter the creek, but there was some fluid infiltration into the shallow soil horizon and some oil sorption into vegetation and surface debris.

Released fluid consisted of 66 m³ of oil and 254 m³ of salt/produced water. No salt impacts were detected along the spill path, but the contaminants of concern (COC) included hydrocarbon fractions

F1 (C6-C10), F2 (C10-C16) to F3 (C16-C34), benzene, toluene, ethylbenzene and xylenes (BTEX).

The steep slope and the presence of merchantable timber, vegetation, leaf litter and organic debris, along with irregular surface contours, presented logistical and safety challenges for efforts to recover the fluid and clean up the area. Further challenges arose as a result of a number of precipitation events, some being significant.

In fact, a storm was predicted to dump about 150 mm of rain two days after the spill. This prompted Earthmaster to delay the selection and implementation of a final cleanup remedy while it prepared for the storm. The firm installed several



Views of area near Bell Hole 3 before and after flushing with the surfactant.

lined bell-shaped holes to catch runoff from the rain.

The application of LIDAR (light detection and ranging) remote sensing following the storm, confirmed that the bell holes were properly placed to prevent liquids from reaching the stream. As it turned out, they were also used for the

final remedy chosen, which was flushing, or washing, as opposed to excavation and off-site disposal of the affected soil.


Excavation and removal is a common solution for many spills into the environment, but it presented several prohibitive challenges at this site, because of potential environmental damage. Deforestation of

the hillside would have brought about erosion problems and a sedimentation threat to the nearby creek. There were cost issues as well, including a requirement to pay upwards of \$50,000 or more for the lost timber to the holder of the forest management agreement that covered the hillside.

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Bioremediation and chemical oxidation were also deemed to be impractical for this particular spill. Bioremediation would not have addressed spill migration, which threatened the waterway, and ongoing monitoring and laboratory services would have been extended for several years and been very costly. Stoichiometrically chemical oxidation is also very costly when used to address free-product spills. It has the potential to kill vegetation, and requires special PPE handling as a hazardous material.

Fortunately, sampling at the site showed that the oil/water mixture that escaped from the containment area had coursed down the hill rather than penetrated into the soil to any significant depth. So, the consultant decided that it could “do a flush” rather than a “scrape”, which, more precisely, was passive and active surface flushing, rather than excavation and off-site disposal.

A surfactant-based remedy was thus deemed optimal, and due to the remediation contractor’s familiarity with the Ivey-sol® surfactant product developed and marketed by Ivey International Inc. (IVEY), that product was chosen for the cleanup job. It is biodegradable, pH neutral, non-caustic, non-corrosive, and free of undesirable impurities.

The Ivey-sol surfactant-enhanced extraction (SEE) products consist of a series of non-ionic formulations that can selectively desorb sorbed contaminants and render non-aqueous-phase liquids miscible in the aqueous phase.

SEE products achieve three goals. Surfactants overcome the “limitation” challenges associated with contaminant sorption and solubility. Then, they lower the relative surface tension of water, thereby improving its wetting and associated hydraulic conductivity properties. Finally, through their selective dissolving of COCs below the critical micelle concentration (CMC), the surfactants broaden the range of contaminants that can be treated. Thus, they enhance in situ and ex situ physical, biological and chemical remediation.

These surfactant products are non-toxic and readily biodegradable, so they do not persist in the environment after application. This can be verified with field surfactant test kits developed by IVEY, and by using any of three U.S. Environ-



Cleanup crews flush forested impact site with Ivey-sol® surfactant.

mental Protection Agency laboratory test methods.

The products have some disadvantages that careful application can overcome. For example, their effectiveness may be diminished if the surfactant/water mixtures freeze during storage, and their deployment may suppress volatile organic compounds, making them less detectable by standard, handheld vapour meters.

Based on the understanding that sorption and free-product formation greatly limit the “availability” of contaminants for remediation, Ivey-sol has the unique ability to selectively desorb contamination at low application concentrations from surfaces, including free-product layers. This means they are more available for physical treatment, as evidenced by this challenging yet positive site application.

The Alberta Energy Regulator approved the use of the Ivey-sol technology at the spill site. The client preferred it to environmentally destructive excavation alternatives.

At the spill site, the surfactant was deployed in varying concentrations, using various delivery methods in a roughly checkerboard configuration. The first trial was completed using backpack sprayers (with a surfactant-to-water ratio of 1:30), followed by pressure-washing.

There was not enough volume in this trial, however, to move the oil to the recovery bell holes for removal. In order to increase pressure and volume, the surfactant and water were mixed in the tank of a small hydrovac truck at a 1:40 ratio for the second trial and applied using the

pressure wand. The oil could be recovered with this application with the right technique, but would splatter if too much pressure was used.

In the third trial, another surfactant-to-water ratio of 1:40 was mixed in the hydrovac truck tank, and the tank hose was used for application rather than the pressure wand. The surfactant effectively washed the oil off the vegetation using this application.

However, there was not enough pressure to move the fluid to the recovery bell holes, and suds were being produced. In order to optimize oil recovery and surfactant usage, ratios of 1:60 and 1:80 were applied and small local trenches were dug to collect and recover fluids.

The surfactant was applied over the course of four days, and the majority of the oil on the hillside was effectively liberated and flushed into the trenches and bell holes for removal. Visual observations indicated that the cleanup operation was generally effective, and soil sampling confirmed these findings.

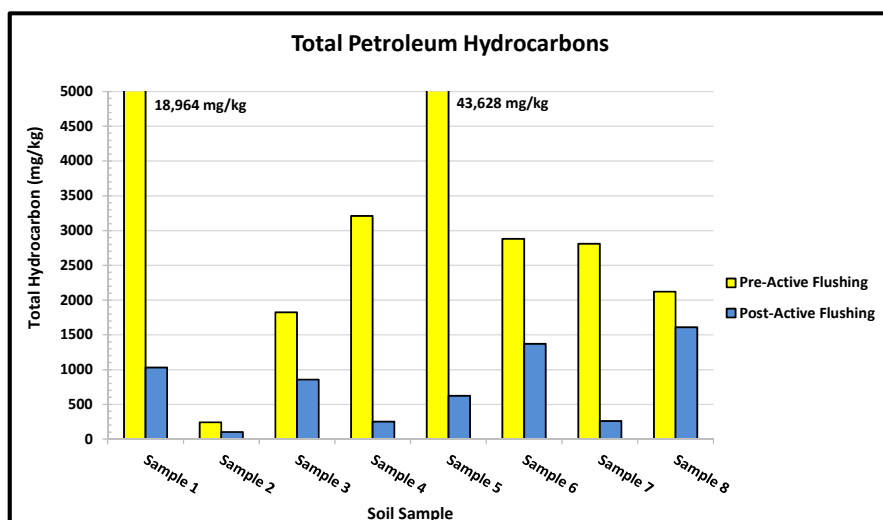
Earthmaster decided that some heavily impacted areas where the leaf litter and vegetation was saturated with oil did not warrant the amount of surfactant and time required for complete removal. As a result, the contractor completed the remediation via surface soil/vegetation removal in these areas.

The flushing operation did not necessarily save much time compared with the typical spill response operation. But, it did realize significant cost savings in terms of avoiding the removal of merchantable

timber on the hillside and the option of excavating and landfilling impacted soil and vegetation.

According to Earthmaster, there were numerous factors affecting project costs, and it was difficult to precisely quantify the cost savings attributable to choosing the flushing operation. The contractor estimates, however, that those cost savings could have been upwards of several hundred thousands of dollars. In light of this consideration, plus the avoidance of environmental damage, the Ivey-sol surfactant-based solution was deemed a sustainable success.

"In July 2019 we were faced with a 320,000 litre crude oil and produced water spill at a facility in northern Alberta," said Adam Dunn, vice president of operations at Earthmaster Environmental. "With our rapid spill response strategy, utilizing the Ivey-sol surfactant remediation technology, we achieved significant time, cost, and environmentally sustainable cleanup benefits, resolving more than 99% of the spill on the hillside." ■



Total PHC Bar Graph.

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ATMOSPHERIC-HYDROTHERMAL MODELLING PLATFORMS OFFER NEW OPPORTUNITIES

By **Greg Rose**

Lake Huron, the third-largest lake in the world, looks placid at times, but it is a complicated place. Currents, winds, upwelling of water from the depths, heat from the sun and air, plus the effects of human activity along the shore, all impact factors such as water temperature.

Bruce Power, located on the shores of the lake and 220 km west of Toronto, Ontario, is the world's largest nuclear reactor complex by number of reactors. Bruce Power asked Golder to help separate the local heating effects of the plant's operations from the variable lake-wide natural factors that affect water temperature. This information would provide accurate data for discussions with regulators, local Indigenous communities and other stakeholder groups concerned about possible influences of the facility's heat profile.

To do this, it would not suffice to study just the waters around Bruce Power's site. Because of the complexity of meteorological, hydrological, anthropological and geo-glacial factors, it would be necessary to model the whole lake, excluding Georgian Bay.

Golder's work creating an atmospheric-hydrothermal computer-based model for Lake Huron, which received a Canadian Consulting Engineering Award in 2019, leads the way in understanding industrial heat impacts, not just on Lake Huron but potentially on other bodies of water as well.

To study Lake Huron, Golder developed a computer-based meteorological and hydrodynamic modelling platform, which drives a computational fluid dynamics engine to simulate the water current and heating processes in the lake.

Many similar models rely heavily on local field data, and this can be a problem on Lake Huron in winter, when field data are scarce because field monitors are frequently lost to storms and ice damage.



Golder's work creating an atmospheric-hydrothermal computer-based model for Lake Huron, which received a Canadian Consulting Engineering Award in 2019, leads the way in understanding industrial heat impacts, not just on Lake Huron but potentially on other bodies of water as well.

Golder's model can be operated without lake temperature or current data, relying only on meteorological model data and lake level data from the National Oceanic and Atmospheric Administration (NOAA), the United States Army Corps of Engineers, and Environment Canada. Local field data, where and when available, are used to verify the accuracy of the model's projections.

OPENING NEW POSSIBILITIES

The benefits of Golder's model are being realized at many levels within Bruce Power. One of these is enabling the organization to address regulatory and stakeholder concerns in a way they never could before. There is now verifiable and transparent information on what effects, if any, the site may be having on the Lake Huron nearshore. Information in the model will also support the company in making decisions, including long-term capital investments.

The model's capabilities are being further harnessed to develop a water quality forecasting system that will help Bruce Power with hypothetical spill scenarios. If an unplanned spill were to occur, the company is able to plan its response, track the spill's movement, and mitigate effects on the fly. The model can help predict the potential timing and magnitude of the impact of spills at sensitive receivers according to changing weather and lake conditions.

Going further, the model can be used to look into the past, to understand the processes at work in Lake Huron during times for which field data is either scarce or non-existent. The model can also be configured to understand the future, including the possible effects of climate change, to plan for the long-term sustainability of Bruce Power's operations. ■

Greg Rose is with Golder. For more information, visit www.golder.com

DRINKING WATER SOURCE PROTECTION IN ONTARIO 20 YEARS AFTER WALKERTON

By **Carl Seider, Mary Lynn MacDonald, Donna Clarkson, David Ellingwood, Amy Dickens, Chitra Gowda, Melissa Carruther and Kyle Davis**

It has been twenty years since a municipal drinking water well in the Town of Walkerton, Ontario, became contaminated with deadly bacteria. Seven people died due to the contamination, and thousands of residents were left with severe long-term illnesses, including neurological damage, arthritis and kidney failure.

It was a tragic event that quickly came under a public inquiry by the provincial government. The inquiry was led by Justice Dennis O'Connor, and resulted in major legislative and policy changes in Ontario to ensure clean, safe municipal drinking water.

ONTARIO'S CLEAN WATER ACT FOR PROTECTING SOURCES OF DRINKING WATER

The *Ontario Clean Water Act* was established in 2006. Administered by the Province of Ontario, this legislation mandates the protection of sources of water for municipal residential drinking water systems. Certain other types of drinking water systems can be included as well.

Under this Act, 19 local multi-stakeholder source protection committees were established to guide source protection planning efforts across Ontario. They are supported by 38 source protection authorities, comprised of Ontario's 36 watershed-based conservation authorities, the Severn Sound Environmental Association, and the Municipality of Northern Bruce Peninsula. Some of the corresponding 38 source protection areas are grouped into larger regions.

The committees developed 38 local plans that contain more than 12,500 policies, to bring about actions to protect sources of municipal residential drinking water systems across Ontario. The

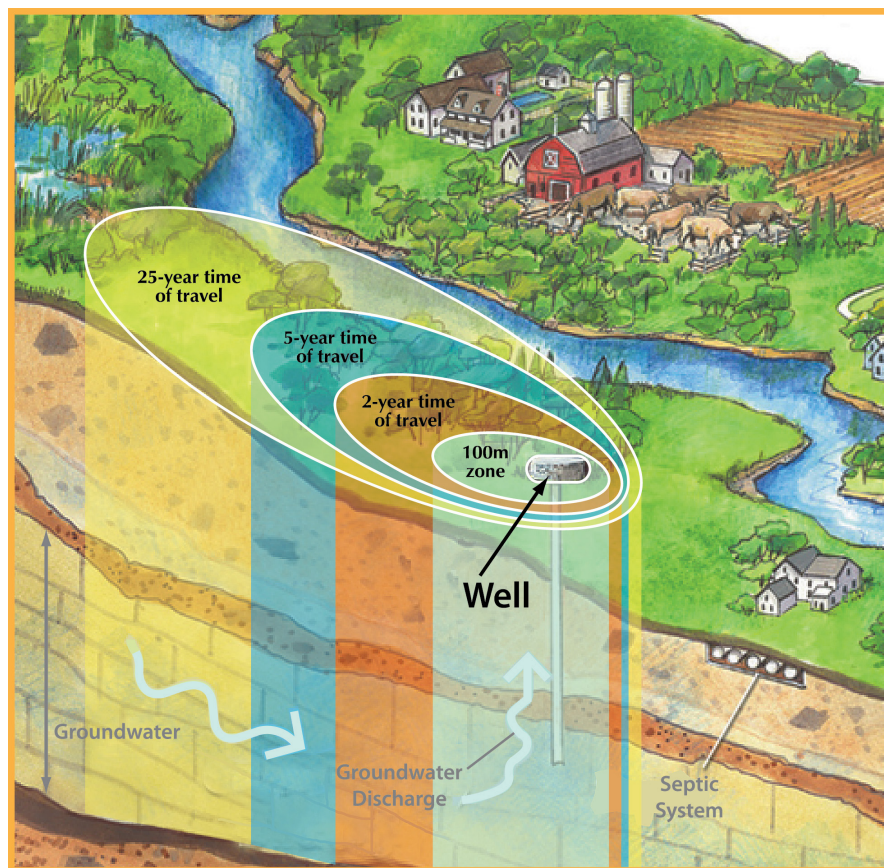


Illustration of a wellhead protection area. Courtesy Conservation Ontario

source protection plan policies are based on strong science. Using local scientific data (like soil type, watershed time of travel of contaminants, depth of aquifer, etc.), drinking water vulnerable areas were delineated per provincial technical methodologies.

There are four types of vulnerable areas: wellhead protection areas, intake protection zones, significant groundwater recharge areas, and highly vulnerable aquifers. If a water quality issue is identified by a committee, an issue contributing area can be delineated within the vulnerable areas. Examples of water quality issues identified in Ontario include nitrate and chloride. Within the vulnerable areas, activities are identified that could pose a threat to drinking water sources under certain circumstances. Risk assessments

determine risk levels of each threat activity as significant, moderate or low.

These in turn influence the policy tool chosen by the committee, and whether the policy is legally binding or not. Various policy tools and their implementers include: land use planning mainly by municipalities; risk management plans by Risk Management Officials (RMOs); educational and monitoring programs by conservation authorities and others; prescribed instruments by the provincial government; and in limited instances, prohibition by RMOs, municipalities or provincial government.

SOURCE PROTECTION PLANS GUIDING LOCAL ACTIONS

Source protection plans have been in effect for around five years. Various

source protection authorities and municipal partnership groups across Ontario describe the progress achieved in policy implementation.

The Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region, comprised of three source protection areas, covers a large portion of Grey and Bruce Counties in Ontario. Project Manager and RMO Carl Seider indicates that the region has the responsibility of overseeing plan policies, including for the municipality of Brockton where the community of Walkerton is located.

The local source protection committee developed its policies through a science-based approach premised on provincial technical rules. For example, the development of Intake Protection Zone – 3 (Event-based Areas) were assessed based on modelled fuel spills of various volumes, to determine the level of risk and appropriate protection measures.

Through this analysis, the majority of fuel handling and storage threats were managed through risk management plan requirements, with only a couple of areas identified as prohibition zones for future fuel storage activities. Risk management measures in these areas include requirements to develop and maintain spill prevention and response plans, secondary containment systems, spill cleanup and disposal measures, and spill alerting and notification systems.

This committee has tapped into expertise available at the Walkerton Clean Water Centre over the years through scientific assessments, policy development and more. The region has worked especially well with partner municipalities through the implementation of land use planning restrictions and *Clean Water Act* Section 59 screening processes to ensure that existing and future drinking water threats are effectively managed.

In this capacity, Grey Sauble Conservation has been designated RMO responsibilities on behalf of 13 municipalities, and has successfully negotiated over 150 risk management plans since the local plan came into effect in July 2016.

Mary Lynn MacDonald and Donna Clarkson are project managers for the Ausable Bayfield Maitland Valley Region.
continued overleaf...



Officials and landowners working together to protect drinking water sources. Pictured: Risk management officials Amy Dickens (top left) and Mary Lynn MacDonald (top right).
Courtesy Quinte Conservation and Ausable Bayfield Conservation Authority



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Algal blooms in Callander Bay in 2017. Courtesy Mattawa Conservation Authority

They are also appointed RMOs, who negotiated close to 100 risk management plans with landowners for activities, including the application of manure, pesticide and fertilizer. MacDonald says that working in a prime agricultural region brings challenges and rewards. Based on her experiences, farmers have always been early adopters of technology, and this helps to protect municipal water supplies.

Risk management plans often reflect the embracing of technology, and include measures such as: specifying GIS data layer options for incorporation into farm guidance equipment and “As Applied” maps reporting the actual application rates, timing and areas covered. Many farmers use certified crop consultants and custom application services, so it is important for those partners to be part of the risk management plan development and reporting process. Innovative ideas, such as soil sampling at double the normal depth for high nutrient requirement crops like corn, can determine if nitrogen and phosphorus have infiltrated past the root zone (and in what levels), by harvest time.

This allows for application rates, timing and method of application to be adjusted as needed in the future. Pesticide licensing, 4-R nutrient training or

other industry certification is also recognized in risk management plans.

Climate change is also having an impact on the watershed, so region staff participated in a climate change vulnerability assessment pilot study. It was led by Conservation Ontario, the network organization of Ontario’s 36 conservation authorities. The Municipality of Huron East generously assisted to gain an understanding of climate change impacts on the source water quality of their wells.

David Ellingwood is the source water protection supervisor at the North Bay-Mattawa Conservation Authority. He reports that cyanobacteria blooms were identified as a drinking water issue for the Callander drinking water system. Callander is a small community on Lake Nipissing near North Bay, Ontario. The microcystin toxins from certain cyanobacteria are a known health hazard. Phosphorus fuels cyanobacteria blooms.

Water quality monitoring has been conducted for over 20 years by the conservation authority in Callander Bay and its main tributary of the Wasi River and Wasi Lake. A phosphorus budget showed that anthropogenic inputs have added to physical conditions in the watershed and the bay to elevate phosphorus levels.

Anoxic conditions develop periodically at the bottom of the bay and liberate phosphorus from the sediments.

Periods of high flows on the Wasi River cause erosion in drains, at culverts and along meanders, adding to the phosphorus load. Charcoal filtration at the water treatment plant can remove the toxins. However, source water protection seeks to reduce contaminants in the first place. The local source protection committee developed policies to address the issue. Septic systems within 120 m of tributaries are inspected every five years under the Ontario Building Code.

Environmental permits, such as for the Callander sewage lagoons that discharge into the bay, have been reviewed. An education and outreach program is ongoing, including practices to reduce phosphorus movement from agricultural and other lands. A successful educational stewardship program called Restore Your Shore has helped prevent erosion and runoff from hundreds of metres of shoreline. Partnerships with academia are helping to better understand the factors contributing to cyanobacterial blooms.

Amy Dickens is the project manager and RMO at the Quinte Region Source
continued overleaf...

REINVENTING THE CHEMICAL DOSING SYSTEM

The **DICE Dosing Module**, by Meunier Technologies, integrates all the necessary discharge components required for a typical chemical dosing system.

The block type design allows for a rigid, compact and reliable product, and the significantly reduced number of connections greatly decreases leakage potential.

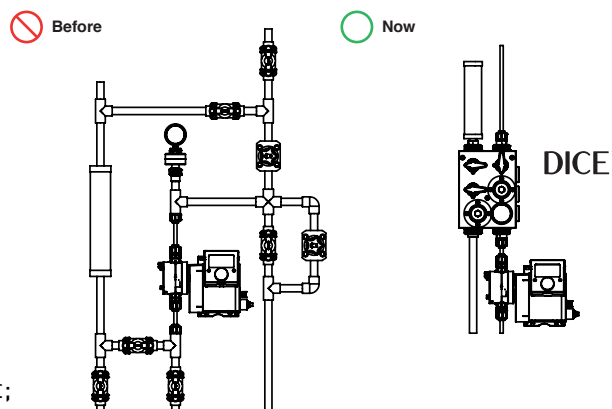
The module allows for better precision and protection in the dosing system, and also features great quality due to its machined fabrication.

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- Capability of calibrating the pump with the correct suction head and discharge pressure.



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Protection Authority. She reports that the authority saw large community buy-in from early on in the program. From 2007 to 2014, stewardship grants supported 90 projects in the region to address activities posing a significant risk to drinking water sources.

Through this grant program, half of all septic systems around the drinking water intake for the Village of Ameliasburgh (Prince Edward County) were upgraded or replaced entirely. As a result, the village's raw water quality results showed a decreasing trend in *E. coli* levels, demonstrating the benefits of protecting drinking water right at the source.

Community buy-in has continued, and is paramount to, the success of the policy implementation stage as well. Dickens also says that when landowners in Madoc Township became aware they would be required to negotiate a risk management plan, they took proactive measures based on information from the region's consultation letters and education materials.

Prior to meeting the RMO, they added measures to their farm operations. This included using the fields closest to creeks for hay only, installing fences to keep cattle out of creeks, and adding vegetative buffers between fences and creeks. Dickens and her colleagues at source protection authorities across Ontario believe that it is also important to highlight the tremendous work and advancements in water treatment and delivery by municipalities.

She and others developed the "Trust the Tap" campaign to commemorate the 20 years since the Walkerton tragedy, and raise awareness about work being done to supply clean, safe municipal drinking water.

The Severn Sound Source Protection Authority, which is not a conservation authority, is part of the South Georgian Bay Lake Simcoe Source Protection Region. This authority consists of eight municipalities, with 32 groundwater systems and two surface water systems.

Melissa Carruthers, RMO for all eight municipalities, reports on progress made. Throughout the pandemic, she continues to provide comments on development applications, respond to landowner inquiries, negotiate draft risk management plans, conduct land use restriction screening, and several other tasks necessary for



Drinking water protection zone road sign.
Courtesy Conservation Ontario

the protection of local municipal drinking water sources.

Prior to the pandemic, negotiations of risk management plans were going well, with buy-in from the industrial, residential, commercial and agricultural community. This was despite the challenges of implementing a prohibition on commercial fertilizer containing nitrogen on 270 residential properties in a nitrate issue contributing area around municipal wells. The same issue contributing area also involves risk management plans with eight agricultural producers, to help manage nutrient runoff.

Besides having a crucial role in drinking water treatment and supply for over 80% of Ontario's population, municipalities implement around two-thirds of the source protection policies in Ontario. This includes land use planning, where planners proactively review development and building applications for source protection considerations.

Kyle Davis is the RMO at Wellington Source Water Protection, a partnership between the eight municipalities of Wellington County, formed to implement five source protection plans. He indicates that this arrangement ensures consistent and efficient delivery while meeting the local municipal needs, and was modelled after other shared service arrangements within the County.

Davis works with County and local municipal staff on all aspects of the program, including delivery of education, review of development applications (approximately 250 per year), verification of activities, including inspection and negotiation of risk management plans, completion of over 640 septic inspections every five years and updates to the County Official Plan and local municipal zoning by-laws.

In 2016, the County Official Plan was amended, along with most of the zoning by-laws in the years following. Davis also notes that there have been a number of technical and policy updates, including water quantity (Tier 3) studies and delineation of new wellhead protection areas and chloride issue contributing areas, since the source protection plans became effective.

ELEMENTS OF SUCCESSFUL SOURCE WATER PROTECTION

Source protection authorities indicate that the success of the Drinking Water Source Protection program in Ontario is largely attributable to the reliance on sound technical information, strong working relationships with local municipalities and provincial ministries. Also, there has been overall support from landowners who understand the need for ongoing protection of our drinking water sources.

Source protection planning continues, as we face ongoing and new challenges including climate change. ■

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COVID-19 DETECTION METHODS AND INFECTIVITY

As wastewater increasingly becomes part of the mainstream conversation during the COVID-19 pandemic as a tool to measure the spread of the virus, the Water Environment Federation (WEF) is reminding water professionals that some testing methods do not assess virus viability or infectivity.

After recently providing an initial primer on COVID-19, WEF released an expansion document in early May to highlight the unlikely survival of infective COVID-19 virus in feces and wastewater systems. In other words, exposure to wastewater is not a significant transmission route for the COVID-19 virus (technically named SARS-CoV-2), WEF officials wrote in their Update and Expansion on The Water Professional's Guide to COVID-19.

While much is still unknown about COVID-19 virus shedding and transmission, the Centers for Disease Control and the World Health Organization state that current evidence does not support that the COVID-19 virus is transmitted via wastewater. WEF's Waterborne Infectious Disease Outbreak Control (WIDOC) working group has been tasked with highlighting the latest scientific findings, as well as topics not previously addressed in the initial field guide posting.

"No coronavirus-specific protections are recommended for workers working in wastewater treatment and collection systems," the WEF update states. "However, as data emerges almost daily with regard to this virus, heightened vigilance in compliance with existing personal protective procedures is appropriate to control exposure," the authors add.

In terms of testing underway to assess the spread of COVID-19, some tests can determine whether the virus can infect cells, while others just look for nucleic acids, also called RNA or RNA fragments, according to WEF. "But viruses need much more than just their RNA to successfully infect cells, so detecting RNA is a little bit like detecting an antibody. It tells you that the virus was once there, but not whether it is still there and is infectious now," states the WEF update.

In examining environmental virology and the various methods used to detect viruses, WEF states that the advent of cell culture assays was a "major catalyst for improving our understanding of waterborne viruses and their transmission routes." In cell culture assays, the posting informs, a water or wastewater sample is added to a prepared population of suitable host cells. This was the detection used for poliovirus surveillance in wastewater in the 1940s.

"Cell culture assays are expensive, time-consuming, susceptible to contamination, and require specialized equipment and reagents," wrote officials in the update, indicating that researchers often opt for other detection methods for several reasons.

WEF also looks at a detection method that has become more popular in the Netherlands, Australia and the U.S. during COVID-19. Known as reverse transcriptase-PCR (RT-PCR), the method is a type of nucleic acid-based test (PCR) used to detect the presence of ribonucleic acid (RNA) viruses.

The WEF update document directs readers to three new studies that investigated the use of wastewater-based epide-



No coronavirus-specific protections are recommended for workers working in wastewater treatment and collection systems.

Credit: MyriamB, AdobeStock

miology approaches to support public health surveillance for COVID-19 infections in communities.

View the full article at www.wef.org/news-hub. ■



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NEW REGULATIONS MAY HELP CONTROL THE COST OF DEALING WITH EXCESS CONSTRUCTION SOILS

By **Jeff Goldman**

For too long, the rules concerning excess soil management in Ontario have existed in a shadowed netherworld, plagued by confusing standards, vague regulations, indifference and outright abuse.

However, the Ontario government's announcement late last year regarding new regulations for the management of excess soil from construction projects is a game changer.

These new regulations will mean greater transparency and accountability in excess soil management practices and will modernize our industry. When coupled with an appropriately resourced implementation program, they also have the potential to provide a foundation upon which Ontario can build world leadership in its excess soil management practices.

However, regulation without user buy-in is not enough. Notwithstanding the process that has allowed industry representatives to have a voice in shaping the new regulations, we recognize that there is often a disconnect between how we should be operating and the realities on the ground. Old ways die hard. This is particularly true in the construction industry, which tends to be family-centric in ownership, multi-generational and tradition bound.

As a land developer, I first became interested in the matter of excess soil management several years ago as a result of asking what I thought was an innocent question of my consulting engineer on one of our projects. Being a curious fellow and, since I am ultimately responsible for paying the tab for expenses related to excess soil being exported from my site, I enquired of my engineer: "So what do you do with all of this soil?"

The response I received was so startling and outrageous that I had to check its veracity for myself. So, I consulted with fellow developers, other engineers, general contractors, soil haulers and



The best excess soil management outcome is when none is required. Creative and beneficial on-site reuse of excess soil should be top of mind.

receivers. They confirmed the essence of what my engineer had said, which was, in Ontario, virtually all excess soil transactions are controlled by one individual and that person is referred to on a first name basis only. Now, I suppose you want to know who this person is and I am here to reveal his name to you. His name is Guy, as in "what do you do with all of this soil?... Don't worry, I've got a Guy!"

Let me be clear that the "I've got a Guy" response was not provided on a "wink-wink/nudge-nudge" basis, as if something untoward were occurring. What startled me about this consistent response from so many quarters, however, was its inherent inefficiency. What if my engineer's "Guy" doesn't know of some other "Guy" who might be able to receive my excess soil at a lower cost?

Could it be that the lynchpin of this billion-dollar industry that has significant impact on our environment rests upon the shoulders of an old-boys network, utilizing local gossip, landlines and

rolodexes for its communication infrastructure? These questions caused me to ask stakeholders, experts and regulators for further information, in order to better understand the state of the industry. Here is what I discovered.

First, the cost of dealing with excess soil management is of increasing concern to the development industry. Rising costs are often attributable to a scarcity of receiving facilities which, partially, has been a result of some municipalities imposing restrictions on receiving excess soil generated from beyond their boundaries. Excess soil costs can impact significantly on construction pro formas. Yet, many developers pay little attention to the matter and simply consider such costs to be part of doing business and don't give much thought to how efficiencies might be achieved.

Project leaders and general contractors, who are often tasked with the logistics of dealing with excess soil management needs, tend to leave such arrange-

ments to late in their planning processes. This results in last minute scrambles, drama and heightened costs, as a home needs to be found expediently for excess soil in order not to hinder construction scheduling.

Those involved in the chain of custody of excess soils, specifically generators, haulers and receivers, remain married to an antiquated, paper-based ticket system for tracking and cost reconciliation. Such systems are inefficient, prone to misuse, and can be a nightmare for back-office accounting.

All of this has been occurring in the context of a regulatory framework that has been confusing, vague and difficult to enforce. Even when enforcement has occurred, it often only resulted in light penalties. So where has been the incentive to change?

In Ontario, dealing with excess soil results in hundreds of thousands of metric tonnes of greenhouse gas emissions generated annually by diesel dump trucks transporting tens of millions of cubic metres of excess soils during millions of trips. Then, there are the estimated billion dollars in costs to deal with excess soil from construction projects.

Developers need to wake up and pay attention to their excess soil costs. In many cases, they are bleeding money unnecessarily and need to demand better outcomes from consultants in this area.

Project managers need to plan for excess soil needs earlier in the project scheduling than has often been done. In reality, the best excess soil management outcome is when none is required. Creative and beneficial on-site reuse of excess soil should be a top of mind goal.

For those involved in the chain of custody regarding excess soil movement, in particular generators, haulers and receivers, there are far more reliable, efficient and time-saving options to the paper ticket system. If, however, you remain steadfast in your resolve to eschew the digital age, good luck in using paper systems to comply with the tracking and record retention requirements of the new regulations. You will be buried in documents.

To those involved in academia and those who are members of professional or business associations representing stakeholders in excess soil management activi-

ties, I recommend the following:

- Do the proper research.
- Educate your constituencies about best management practices.
- Agree about and improve the qualifications for those designated as Qualified Persons.

Municipal governments have the absolute right and responsibility to control dump truck traffic with regards to noise, dust, routing and road degradation. However, if they closed their doors to receiving construction soils generated from beyond their boundaries primarily because of concern regarding the provenance of the soil, the new regulations go a long way to assuring that what you see is what you get.

Couple that with new soil tracking and accountability technologies in use today and the objection to receiving such soils crumbles. They are also missing out on opportunities that other municipalities, who have adopted advanced provenance compliance requirements as a condition of accepting outside soils, enjoy. These include restoration of ugly and sometimes dangerous exhausted extraction sites and

transforming them into community amenities, as well as a share of tip fees from these activities to fill their coffers.

Construction financiers and risk underwriters, I query why you are so cavalier with your money. You need to start requiring efficient, transparent and verifiable excess soil management plans as a condition of lending or insuring.

Change in this industry is coming and it will require us to revisit our long-held attitudes and practices in order to provide better outcomes. The smart money will bet on those ready to give excess soil the attention, respect and practice modernization it deserves. ■

This article was excerpted from the author's keynote speech delivered to the Canadian Urban Institute's 2019 Excess Soil Symposium, attended by about 400 engineers, geoscientists, industry and government representatives.

Jeff Goldman is with SoilFLO Inc. Email: jeff.goldman@soilflo.com

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VILLAGE'S WASTEWATER OXIDATION DITCHES STILL IN SERVICE AFTER 57 YEARS OF OPERATION

As the Village of Montrose in British Columbia prepares to upgrade its wastewater treatment facility, the makers of the still-working, original aeration technology can safely say that their engineering products are built to last. Installed by Lakeside Equipment Corporation back in 1963, the oxidation ditches may be the longest lasting engineering of its type to still be in working order anywhere.

At the time, the installation was state of the art and the process is still working well. Only now is an upgrade needed. Mike Walsh, mayor of Montrose, said that his father Martin Walsh pushed very hard for the village to get efficient and long-lasting treatment systems. Together with his colleagues, they certainly chose wisely.

He added that: "When the 'racetrack' (now known as the Lakeside closed loop reactor (CLR) process) was installed, the design allowed for expansion, which occurred in 1980. We've had no major problems at all. It has just kept on working."

For most wastewater treatment plants, Lakeside's racetrack design with common wall construction has proved the most economical option. However, over time, to meet ever-changing and more stringent effluent standards, the reactor has been developed to take on several shapes. These include the Folded U and Concentric Multichannel. For small plants, there is a round packaged design with an internal final clarifier that offers lower construction and equipment costs.

The CLR process consists of one or more reactors with a single feed point for raw wastewater and return sludge. The basic design at Montrose uses a simple racetrack configuration that provides a straight-line flow pattern for wastewater between the headworks and the final clarifiers. At the core of the CLR process is the horizontal magna rotor, which sustains a high population of microorganisms in the reactor to provide simple process control. The magna rotor provides precise oxygen input into the bio-



The Montrose wastewater treatment plant has been operating since 1963.

logical process through adjustment of rotor immersion by raising or lowering the level control weir and by adjusting the rotational speed.

It provides an oxygen transfer range greater than any other mechanical surface aerator, with a range of 3.25-to-1 at immersion depths from 12 – 40 mm. The addition of variable frequency drives to allow the full speed range from 37 – 72 rev/min increases the oxygen transfer

range to 9.7-to-1.

This wide range of oxygen transfer allows the treatment plant operator maximum flexibility to provide oxygen input (horsepower) to match the demand of the system, without the need to reverse direction of rotation.

As with all aeration devices, transfer efficiency varies with transfer rate. With the proper combination of speed and immersion, optimum performance can



Mike Walsh (left), mayor of Montrose with treatment plant operator Greg Parker.

be maintained to match virtually any set of loading conditions. Optimum performance assures the lowest operating power cost throughout the life of the equipment.

The CLR process provides the proper environment for both nitrifying and denitrifying organisms. Autotrophic nitrifier populations result in a high mixed liquor suspended solids concentration, increased aerobic hydraulic detention time, and long sludge age (20 or more days) to achieve nitrification. CLR plants consistently produce effluent $\text{NH}_3\text{-N}$ levels of less than 1 mg/l with proper control of aerobic conditions and can provide total nitrogen levels as low as 5 mg/l with proper control of anoxic conditions.

Its denitrification process recovers 50% of the total alkalinity lost during the nitrification process, lowers overall energy costs by reducing oxygen requirements and inhibits filamentous bacteria growth.

A positive dissolved oxygen concentration is maintained throughout the reactor by controlling both the rotor blade immersion in the mixed liquor and by changing the rotational speed of the rotor using variable frequency drives. This simple control strategy can achieve high removal levels of BOD_5 and TSS to less than 10 mg/l, as well as nitrification to reduce effluent ammonia ($\text{NH}_3\text{-N}$) to less than 1 mg/l.

During peak wet weather conditions, solids from the reactors can be pushed rapidly into the final clarifiers. Solids will accumulate in the clarifiers to a point

where solids washout may occur. To prevent this, the treatment flow pattern is converted to a “contact stabilization” model during the time the peak flow rate exists.

When the process requires two or more reactors, the CLR process can be designed to operate in parallel, series, or storm flow modes of operation to provide maximum operational flexibility. Operational control is provided by a splitter box arrangement for both raw wastewater and return activated sludge. Typically, slide gates are manually operated. For more sophisticated control, the slide gates can be electrically actuated to meet changing flow and load conditions.

The primary component of the CLR process is its horizontal rotor aerator, which provides oxygen to the biological mass, mixes microorganisms uniformly, and adds mixing velocity to the channel to prevent solids from settling.

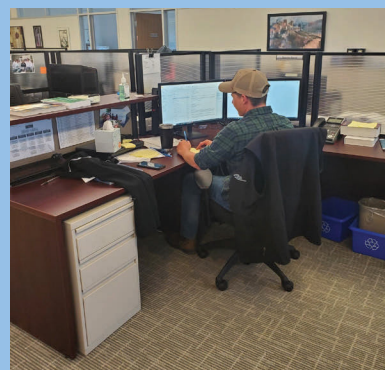
Montrose recently made a successful bid for funding under the Infrastructure Canada Grant Program, receiving \$1.8 million towards the total cost of \$2.5 million to upgrade the plant. The work will include a new electrical system, restoration of the oxidation ditch and two clarifiers. There will also be a new headworks, control building and improvements to the pipe and valve systems. Upgrades to Montrose’s plant should be completed by the fall of 2021. ■

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CAREFUL SELECTION OF ODOUR ASSESSMENT METHODOLOGIES IS IMPORTANT FOR ACCURACY

By Anna Bokowa and Magdalena Bokowa

Odour assessment methods are divided into two categories: assessments at potential sources, and ambient assessments at affected areas, which are usually residential areas located close to potential odour sources. There is no standard method for odour assessment, but it can include, or be a combination of, several approaches:

Source odour and/or specific compound testing with analysis and dispersion modelling can predict off-site odour concentrations. This is the most common method for assessing odours at the source.

Ambient sampling with odour panel evaluations is a very common approach to assess odours in residential and complaint areas.

Odour monitoring, using portable instruments, such as the Nasal Ranger or Scentroid SM100, is a very inexpensive method for measurement and can be used as a screen tool.

Ambient monitoring using the grid method is commonly used in Europe. However, it is very expensive, requiring a large data base and therefore months of observations. Most data are based on one-person observations and this depends on his or her sensitivity. The data can vary easily if persons with different sensitivities towards odour perform this type of assessment.

Continuous odour monitoring using electronic noses can be very expensive, difficult to use and is not applicable for all types of sources. Also, sensors need to be changed frequently and calibration is required before use.

Continuous specific compound or a group of compounds monitoring can be applied to source or ambient monitoring. Continuous monitors typically measure concentrations for individual odorants or a group of compounds every few seconds and record the data as a one-minute average value.

Some of these systems are easy to operate, but most are complex, and installation and operation require extensive technical expertise. There are also some limitations such as the detection limits for the instrument. Some odours may be detected by a human nose, but not detected by the instrument. Problems may occur with interferences and false responses of the instrument.

Specific compound sampling followed by specific analysis requires that for different measured compounds a different collection media is used. Sampling is inexpensive but the analytical cost may be expensive, depending on the compound. Some odours may be detected by the human nose but are below the analytical detection level.

Community odour surveys are usually performed by screened and trained independent observers downwind from the potential source. The number of observers will depend on how large is the facility, the budget for the project, the ter-



The Nasal Ranger is a very inexpensive method for measurement and can be used as a screen tool.

rain and other factors. Community odour surveys can be an effective alternative or supplement to source testing for odour. This is particularly true in cases where there are a number of potential odour sources that can affect a community, where sources are difficult to sample, or when sources are expected to vary with meteorological conditions. Usually observations are made periodically over an extended time frame.

A large data set is required to determine the odour levels at specific locations and under a range of weather conditions. This requires a long period of observations and therefore it can be very expensive. If community odour surveys are performed by community members, or by staff from a facility, it may lead to adaptation to particular odours, and could therefore tend to underreporting odour occurrence. To avoid this limitation, independent outside observers should be used.

In most cases, due to unavailability or for safety reasons, observations are not performed during early morning or late-night hours when odours could be at their worst. Therefore, it is easy to underestimate the actual situation in the affected area.

Resident observations and questionnaires for residents involve logging of odour observations by an individual, such as the intensity of the odour, character, duration and pleasantness. Date and time of the odour episode is usually also recorded, as well as environmental conditions at the time of the episode. This method is not expensive and is easy to use. It just requires short training and screening for residents. It may

be helpful for initiating an investigation of potential odour or potential odour sources in the area.

ANALYSIS OF TESTING, EVALUATION AND DISPERSION MODELLING

The general approach for odour testing at the source is to first select the potential source at the facility, collect odour samples, perform analysis using dynamic olfactometry, and then use dispersion modelling to predict off-site odour concentrations at sensitive receptors. These predicted by model odour concentrations could be verified by actual ambient odour sampling at sensitive receptors on the days of the odour testing at the source.

Several factors should be considered before or during assessments, including:

- Careful selection of all potential odour sources in the plant, including point, area and fugitive sources.
- Determination of any odour background before testing commences. It is important to determine any other potential sources in the area.
- Methodology used for collection of samples from sources.
- Number of collected samples should be representative of the actual process of the assessed facility.
- Determine if the process is continuous or batch.
- Odour analysis techniques.
- Dispersion modelling analysis.

There are different methods for odour sampling and they vary by jurisdiction. Compliance sampling in Ontario follows the MOE Ontario Source Testing Code, Method ON-6 Determination of Odour Emissions from Stationary Sources.

Different sampling techniques will apply to different types of odour sources:

- A point source is a single, identifiable source of air pollutant

or odorant emissions. Point sources are characterized as being either elevated or at ground level. Point sources will have a defined exhaust diameter. Examples include stacks and vents.

- Area sources are two-dimensional sources of diffuse air pollutant emissions. The dimensions of these sources are either known or can be estimated. These include primary or aeration tanks at wastewater treatment plants, tailing ponds, etc.
- Fugitive sources can be any open doors or windows, and trucks waiting to unload or load odorous material.

At a point source during testing, odour samples are usually dynamically diluted with nitrogen. For this, a dynamic dilution sampler is usually used to collect samples. After collection of samples at the source, they are evaluated for odour detection threshold values (ODTV), which, together with volumetric flow rates measured at the source, result in the determination of odour emission rates from the source.

For some point sources where expected odour is low, a lung sampling method may be used for collection of the samples. Lung samplers contain a pump which creates a vacuum inside a sealed container (a vacuum chamber). This draws a source sample into the sample bag.

When estimating odour emission rates from area or fugitive sources, it becomes more complicated. There are some challenges when it comes to assessing odours from any area, or fugitive sources, mostly because of the difficulty in accurately measuring emissions from these potential odour sources. Therefore, careful selection of the method is important for proper assessment.

continued overleaf...

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There are five methods commonly used to predict odour emissions from area sources. They are the flux chamber method, portable wind tunnel method, a back calculation with an air dispersion model method, static hood method, and the mass transfer method.

For fugitive sources, a back-up calculation method is commonly used for estimation of emissions from these sources. When estimating fugitive emissions, the following steps are usually required:

- Collect ambient samples within the cavity of the building or structure attached to the fugitive source.
- Evaluate the collected samples using dynamic olfactometry.
- Calculate cavity concentration.
- Calculate the dilution factor.
- Calculate odour emission rates using the formula:

Odour Emission Rate (ou / s) = Dispersion Factor (m³ / s) x Ambient Odour Concentration (ou / m³).

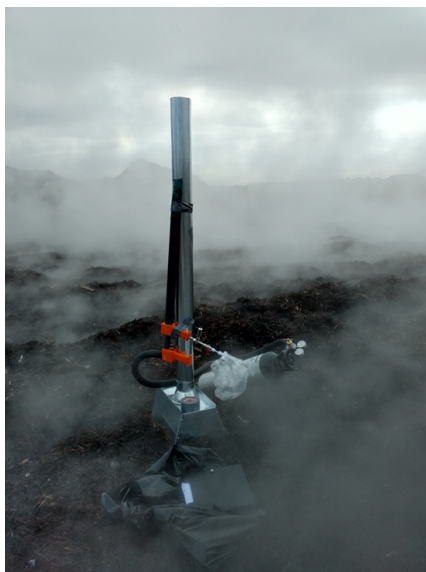
In order to predict off-site odour concentrations at selected sensitive receptors, the measured or estimated emission rates are used in the dispersion modelling analysis. Odour models can be classified according to their working principles. In Ontario, only two models are approved for regulatory purposes: AERMOD and CAPUFF. In order to run dispersion models for odour assessments, several inputs are necessary, such as emission and source parameters, including nearby buildings, meteorological data, terrain data and land use characteristics.

AMBIENT ODOUR ASSESSMENTS

When it comes to ambient odour assessments there are different techniques and they may vary from jurisdiction to jurisdiction. In Ontario, the most popular method is ambient odour testing and dynamic olfactometry analysis.

Ambient sampling for odour assessment is typically conducted using the lung sampling technique, with the sample collection done in ambient air rather than within a source such as a stack.

This is one of the most common methods to assess ambient odour, provided the concentration is sufficient to give odour panelists' responses at the lowest dilution levels of the olfactometer. If the odour concentration is too low for



The static hood method is one of five options commonly used to predict odour emissions.

a sample to be evaluated by olfactometry, then the panelists can evaluate the sample directly from the sample bag.

The lung sampling procedures for ambient odour monitoring are similar to sampling at the source using the lung method, except that the sampling probe is located about 1.5 m above ground level. However, specific heights may be selected based on the nature of the monitoring program. Sampling periods depend on the jurisdiction (e.g., 10 minutes in Ontario) but can vary depending on the nature of the upwind source and meteorology.

AMBIENT ODOUR MONITORING

A field olfactometer, such as the Nasal Ranger or Scentroid SM100, directly estimates odour concentration in the ambient air without the requirement to collect a sample in a container.

The field olfactometer, which is used by one person at a time, draws ambient air into the instrument. The diluted sample is presented to the odour observer via a face mask and the observer indicates whether an odour can be detected at each dilution. The results from the Nasal Ranger are used to calculate the detection to threshold (D/T) which is the number of dilutions needed to make the odour ambient air non detectable.

All field olfactometers are based on individual one person readings for one-minute maximums, whereas ambi-

ent sampling for laboratory olfactometry generally occurs for a longer time. Due to this short time frame, accurate results cannot be guaranteed; therefore, it should be considered a screening tool only. As one observer operates the instrument, results depend on their sensitivity. In addition, the observer likely breathes odorant before using the field olfactometer, increasing the opportunity for odour fatigue.

CONCLUSIONS

There are different methods for assessing odours; however, they will depend on several factors.

Careful selection of the methodology to be used should be made before any assessments are performed.

Consideration should be given to assessing the location's jurisdiction; the appropriate standards that need to be met; the amount of time available for assessment, whether it be days, months or years; and the financial budget allowed for the project. Careful thought should also be given to the type of sources tested (point, fugitive and area sources) and the difficulties in being able to assess them.

Lastly, any investigation should attempt to yield the most accurate results and therefore a variety of assessment methods can and should be used so that underestimation does not occur. ■

Anna H. Bokowa and Magdalena A. Bokowa are with Environmental Odour Consulting Corporation.

Email: bokowa.anna@environmentalodourconsulting.com, or bokowa@gmail.com. (References available upon request)

NUTRIENT KIT ENGAGES COMMUNITY TO TAKE LEAD ON ALGAL BLOOMS

The University of Saskatchewan's Global Institute for Water Security has designed a new communitybased sampling app kit to engage citizens, farmers and water quality managers in identifying and remediating algal bloom hotspots through the real-time monitoring of dissolved nutrient concentrations in wells, streams, wetlands and lakes.

Called the Nutrient App, the mobile application allows users to dip and photograph test strips for nitrates and phosphates to instantaneously measure nutrient loads.

The cost of algal blooms for Lake Erie alone is estimated to amount to \$5.3 billion over 30 years if nothing is done to reduce phosphorus loading to the lake, experts estimate.

In the summer of 2017, cyanobacteria discovered in a popular Victoria-area lake in British Columbia was suspected in the deaths of several dogs on Vancouver Island. That same year, research by the University of Alberta indicated that the cyanobacterial toxin microcystin had been found in 246 water bodies in Canada.

"Community-based monitoring creates awareness of environmental problems and provides tremendous opportunities to address the need for research data resulting from lack of stable funding for monitoring programs," said University of Saskatchewan research scientist Diogo Costa in an interview for the school's 2020 Young Innovators series.

In collaboration with computer scientists Banani Roy and Kevin Schneider, Costa, who also works with Environment and Climate Change Canada, developed the app as part of his recent post-doctoral work in hydrology with colleagues John Pomeroy, Helen Baulch and Jane Elliott.

To measure nitrate with the app, a user simply dips a test strip into the water in question, then photographs the strip against the provided reference point to upload to the app. To measure phosphate, a user fills a vial with the water sample, mixes it with the reagents found in the kit, and photographs the vial against the provided reference point to upload to the app. The app can then calculate the estimated concentrations of both nitrate and phosphate.

The app will log the test results and the sample location for future reference. The results can be sent to a USask database that creates a map of the nutrient hotspots available on the app's website. Measurements are georeferenced and can be uploaded to a server managed by the Global Institute for Water Security's data management team. The results will be displayed in a map that can be visualized directly through the app or from a web browser for further analysis. ■

For more information, visit www.gwf.usask.ca



University of Saskatchewan research scientist Diogo Costa uses the Nutrient App to test nitrate and phosphate concentrations in pond water. Courtesy Dave Stobbe/University of Saskatchewan

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An ROV equipped with a sediment sampler was used for one Lake Ontario zebra mussel assessment.

USING ROVS TO IMAGE UNDERWATER INFRASTRUCTURE FOR STRUCTURAL INTEGRITY

By **Blake Spittle**

Underwater remotely operated vehicles (ROVs) have come a long way with the acceleration of technology. Historically, they had huge operating costs and logistics, including the need for vessels to carry them to sites, power sources to run them, and teams of technical personnel to navigate and maintain them below the water's surface.

Advancements in computers, batteries, cameras, drones and robotic engineering have resulted in the manufacture of small and compact ROVs. This has opened up new opportunities for engineering and scientific professionals to use them, no matter the geographic location or water type. There is no longer a need for a vessel to launch from, a power source for operation, or a team of technical personnel. This saves time, reduces costs and increases safety.

As developments accelerate, often left behind is the knowledge and understanding of how these small underwater robots can be applied and utilized.

Imaging civil infrastructure underwater for structural assessments and reporting is becoming very popular and is achieved by an ROV in a very efficient and safe way. Engineers do not have to worry about hiring a dive crew and the health and safety implications and liability that can pose. Using an ROV means no one enters the water. It is navigated from the surface by a "ROV Pilot", with all imagery, including video and photos, relayed live back to the controller and recorded simultaneously.

The result is hours of imagery of submerged assets in a single day, giving non-biased, high definition video and photo data.

REMOTE BRIDGE INSPECTION

In one example, a small river runs under a remotely located trail bridge, located 50 km away from the nearest town. The bridge is accessed by a trail in the forest, and its last inspection date is unknown. Engineers want to do a below surface visual structural check first.

It would be too costly to use a professional diver and too remote for a power source. The mini ROV is fully battery powered, offers 4K HD filming, and has a 2.5 knots maximum speed so the small current is no issue. Within an hour the bridge is imaged, all pillars, beams and supports are inspected, and the imagery is sent to the project engineer.

PUBLIC BOAT LAUNCH

Floods have put pressure on a public boat launch dock, so municipal staff

want an imagery analysis to determine if there was any damage to it. Working from the dock, or from the shoreline, the mini ROV can be placed into the water and all pillars, beams, cribs, concrete and supports can be imaged.

WATER TREATMENT PLANT CLEAR WELLS

Periodically, water treatment plant clear wells need to be inspected to determine the condition of the concrete and the piping. Also, there is the need for overall structure visuals, if installation of new pumps is planned.

With equipment designed to be disinfectant and operated safely in potable water, mini ROVs allow for inspections in clear wells. This eliminates the need to send scuba divers into these tight spaces, and the concerns about confined space entry, or having to drain the clear well just for an inspection. Operators of the plant only need to shut down and isolate the clear well for a limited time.

OTHER USES

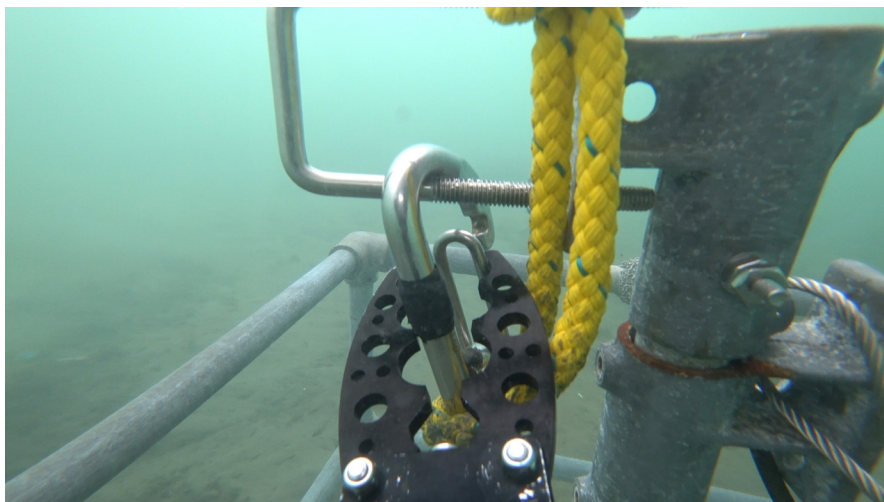
Imaging is not the only capability of mini ROV equipment. While cameras have changed substantially, other technologies have also become more powerful and compact. This includes imaging sonar, designed for low visibility waters.

ROVs can also be equipped with steel thickness gauges, multi parameter water quality sensors and water sediment sampling. Laser scalers can measure cracks and separation in concrete, bolt head sizes and even aquatic wildlife size. Multi-function manipulator arms give ROVs the ability to retrieve items from the water.

Aquatic habitat research and reporting is also done now with ROVs. With six to eight hours of battery life, they are a systematic and efficient way to get the maximum amount of underwater time. This means much more can be achieved in a day than using divers, where time under water is limited and stand down time is mandatory.

A world of regulation around monitoring and researching aquatic habitats has meant efficient workflows to capture as much underwater data as possible, often on limited budgets.

On one marine construction project, the lakebed and fish habitat condition



An ROV helped retrieve this water testing frame by attaching a carabiner and rope.

needed to be evaluated. Before construction began, a mini ROV systematically imaged all areas that would be affected by the construction. It was used again after construction and rehabilitation to document before and after conditions.

In a fresh water mussel assessment, a mini ROV was equipped with a sediment sampler. Sediment samples were collected and returned to the surface for on-site or laboratory analysis.

Tight closing mechanisms allow for a good seal, so the sample is not compromised. This was all imaged at the same time, so the researcher could see on video the aquatic environment around the sampling location.

A water sampler can also be integrated in this scenario if water analysis at varying depths and locations across the area is required, or if it helps the researcher understand the underwater environment in further detail. Multi parameter ROV water quality sensors mean the collection of water samples can be eliminated and replaced with live time water quality data collection while imaging.

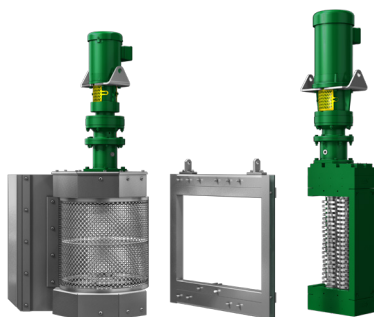
RECOVERY

Another use of mini ROVs is the retrieval of lost or hard to get to research equipment. Take an acoustic receiver, unable to resurface as damage to its floats or releasing mechanisms occurred during its deployment underwater. With multi-function grabber arms attached, the mini ROV can easily be taken to remote locations anywhere.

If the location is known by GPS, the ROV dives in that area and through a variety of claw like attachments, can lock onto the body of the acoustic receiver. The ROV can then be tethered or driven back to the surface. Imaging sonar can be viewed on screen also, if the ROV is equipped for the identification of such items in low visibility waters. This is a low risk operation, as no one is entering the water. It is cost-effective as not only is the expensive unit returned safely, but the valuable data that it contains is also retrieved.

Retrieving larger items can also be done by using a mini ROV with retrieval lines. In one instance, a water sensor frame had to be recovered. A float/buoy and line was attached to it, but over the season it disappeared. A retrieval line with a carabiner held in the open position by the ROVs grabber claws was taken down, all while being viewed in live time by the surface controller. It was piloted carefully onto the correct part of the sensor frame. Once in place, the grabber arms released the carabiner, closing it on the item. Then, the retrieval line was used to lift the frame back to the surface. ■

**Blake Spittle is with Completewaters.
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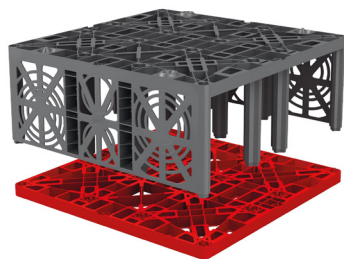
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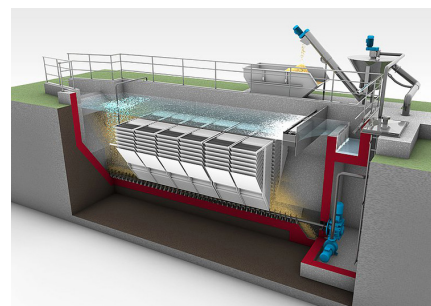
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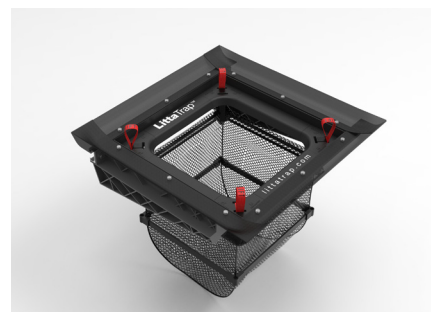
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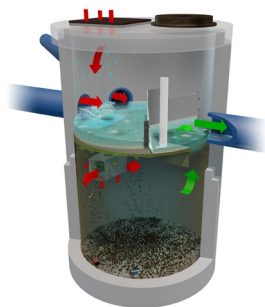
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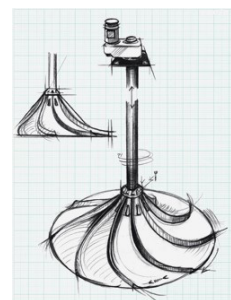
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Waterloo Barrier is a low permeability cutoff wall for groundwater containment and control. It is a new design of steel sheet piling, featuring joints that can be sealed after the sheets have been driven into the ground, and was developed by researchers at the University of Waterloo. It has patent/patent pending status in several countries. Canadian Metal Rolling Mills assisted in developing the product.

Waterloo Barrier

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FCM CALLS FOR \$10B IN COVID-19 FUNDING

From turning arenas into safe shelters to deferring property taxes or user fees, new data from the Federation of Canadian Municipalities (FCM) shows that COVID-19 is costing cities some \$10 billion to \$15 billion in non-recoverable losses. Now, the organization that has long been the national voice of municipal government is calling for the federal government to step up with emergency cash to stem the financial bleeding.

When they include unpaid municipal utility charges, or an estimated \$400 million each month from lost transit ridership alone, many municipalities are spending unprecedented dollars on measures such as setting up portable hygiene stations as critical steps to support public health and safety, a new FCM report outlines.

To fill the gap, FCM is urging the federal government to earmark at least \$10 billion in emergency operations funding, including at least \$7.6 billion in direct federal allocations to all municipalities, plus \$2.4 billion for those with transit systems. FCM recommends that the administrative infrastructure of the federal Gas Tax Fund could be leveraged to expedite the rollout of dedicated emergency operating grants.

GROUPS WARN OF ENVIRONMENTAL LAW ROLLBACKS

Sixteen environmental action organizations have come together to write a single letter of concern to Canadian Prime Minister Justin Trudeau. Their message is to resist pressures to weaken or delay implementation of federal environmental laws under the climate of the COVID-19 pandemic.

Of particular concern is what they see as a concerted effort from the Canadian Association of Petroleum Producers to request a "COVID-19 Market Crisis Joint Working Group". EcoJustice, Environmental Defence, the Canadian Environmental Law Association, and the other 13 environmental action organizations in the letter to Trudeau fear the working group could intend to exploit the pandemic crisis to achieve the oil and gas industry's own ends.

PLASTICS RE-EMERGE AS CONVENIENT ALTERNATIVE

The impact of COVID-19 has not only forced some of Canada's environmental protection services to be temporarily suspended, it has also delayed the implementation of new environmental protection legislation.

From the closing of a Calgary recycling plant due to a COVID-19 outbreak, to British Columbia's endorsement of plastic bags that were set to be banned on a national level, Canada is experiencing some environmental fallout in most provinces during the ongoing pandemic, as *continued overleaf...*



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are many jurisdictions around the world.

"As the COVID-19 virus spreads across the country, single-use plastics will only become more vital," advised the U.S.-based Plastics Industry Association at the beginning of the pandemic, referring to items such as surgical masks, gloves, protective equipment and body bags.

Canada, which has been moving towards a single-use plastic ban under the *Canadian Environmental Protection Act*, recently extended the required comment period on a scientific assessment of the problem. Federal Environment Minister Jonathan Wilkinson told *The Canadian Press* that while Canada is still committed to banning single-use plastics, some delays are to be expected under the pandemic.

CWWA PROVIDES GUIDANCE FOR RE-OPENINGS

As governments plan for the gradual re-opening of the economy, the Canadian Water and Wastewater Association (CWWA) has released guidance documents advising water utilities and building owners on how to safely re-open

buildings shuttered by the pandemic.

Schools, recreational facilities, entertainment venues and retail buildings have been closed for weeks as a result of shutdown orders. With no occupants, water in the plumbing systems of these buildings can become stagnant, posing microbial and chemical health risks.

According to the CWWA, effects of water stagnation will vary between buildings, depending on a range of factors such as length of shutdown, number of occupants, complexity and integrity of plumbing, and whether or not maintenance has been performed during the shutdown.

Both water utilities and building owners are responsible for the safety of water within their respective properties and distribution networks, said the CWWA.

Part One of the CWWA's guidance document is for water utilities and provides advice on preparing for increased water flushing; recommendations on informing building owners; and guidance on communicating with council, the public and the media.

Part Two of the guidance is aimed at building owners and operators and pro-

vides general instructions for flushing and cleaning water systems, as well as links to more detailed resources and information.

The CWWA is encouraging utilities and owners to adapt the fact sheets as needed to reflect their own situations and water parameters such as chlorine residual and temperatures.

www.cwwa.ca

BC FORESTRY COMPANY SPILLS DIESEL FUEL

As the result of a failed fuel transfer process, a forestry company has admitted responsibility for spilling some 4,500 litres of diesel fuel into waters near the Mouth of Dinan Bay on Haida Gwaii, off the coast of British Columbia.

Haida Gwaii-based company Taan Forest, which procures and sells timber, indicated in a statement that during the early morning hours of April 22 a valve failed when feeding diesel to an electrical generator on the company's barge.

According to the company, oil-absorbing booms and sorbent pads were deployed directly following the spill, with particular effort directed toward keeping the diesel plume away from the shoreline and mouths of nearby rivers, especially those where sockeye salmon are expected to return. Biologists continue to sample water, soil and marine life to assess impacts from the spill near Masset Inlet.

CANNABIS WATER USAGE REPORT

Later this year Resource Innovation Institute (RII), the Berkeley Cannabis Research Center and New Frontier Data will publish *The Cannabis Water Report*, which will study water practices and usage rates across a range of cultivation methods and geographies and will offer strategic recommendations for governments and other stakeholders.

"Resource Innovation Institute has been exploring cannabis energy issues for years, and now we're expanding our scope to include the critical subject of water," said Derek Smith of RII.

"As the cannabis industry expands globally, optimizing the resources used to grow cannabis will be vital to improving cost efficiency in an increasingly competitive industry," said Giadha A.

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NO ACTION RECOMMENDED AFTER CSO DISCHARGE

Following a provincial order to determine the environmental impact of a four-and-a-half-year long accidental discharge of stormwater runoff and sanitary sewage into Chedoke Creek and Cootes Paradise, a new consultant's report is advising City of Hamilton, Ontario officials not to remediate the areas in question.

Due to a bypass gate left unintentionally open at a combined sewage overflow (CSO) tank, Hamilton officials estimated that approximately 24 billion litres of combined sewage leaked from 2014 to 2018 into Chedoke Creek. The creek in turn outlets at the south shore

of Cootes Paradise Marsh, part of a nature reserve owned and managed by the Royal Botanical Gardens.

A report prepared by SLR Consulting Ltd. found that concentrations of potential contaminants related to surface water quality were "comparable" to concentrations before the spill, supporting the conclusion that "there is no evidence of long-term impact on Cootes Paradise."

CORAL ISLANDS MAY NOT 'DROWN'

A new study, co-led by Simon Fraser University Dean of Science Paul Kench, has found that coral reef islands globally may be capable of adapting naturally to any sea level rise in the face of global warming.

The study, published in the journal *Science Advances*, suggests that these islands, thought to be at risk of "drowning" and becoming inhabitable due to increased flooding within decades, may be adaptable due to a process by which beach sand transfers during flooding to the island's surface, building up the island's elevation. Previously, it was thought islands did not change as sea levels rise.

Researchers developed a new model that enabled them to predict how the islands will change over the next century. "Such a model is critical to support small island nations to develop improved adaptation strategies," says Kench, who has studied coral reef islands for the past two decades. Nearly one million people live on low-lying reef islands.

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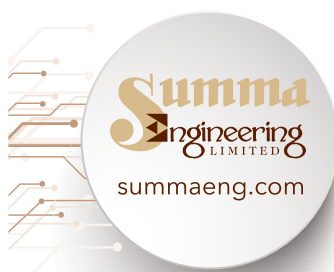
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